PRACTICAL ENGINEER

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POWERFUL HOSPITALITY

STEAM AND ELECTRICITY IN THE SERVICE OF A HOTEL'S GUESTS

FRONT, SHOW THE GENTLEMAN to 738." And "Front" grabs the key and your bags, conducts you aboard the elevator, and whisk you go up 7 stories to a room, brilliantly lighted, delightfully warm, attractively arranged, with all the comforts that modern ingenuity has devised to rest the weary mind and body. It is not always so, but in the best of modern hotels it is and so it is in Hotel Radisson at Minneapolis.

To the curious person who likes to pry into the how of other people's business comes the wonder—whence this magic, which puts at my elbow all the resources of the world, all the people in the land that I may call them at my wish by the pressure of a button. And an inspection of the "innards" of the hostelry shows the twin giants, steam and electricity, to be the magician's servants. Right well have they been used, too. But to understand how well we must spend a time below stairs and above, exploring the method of their use.

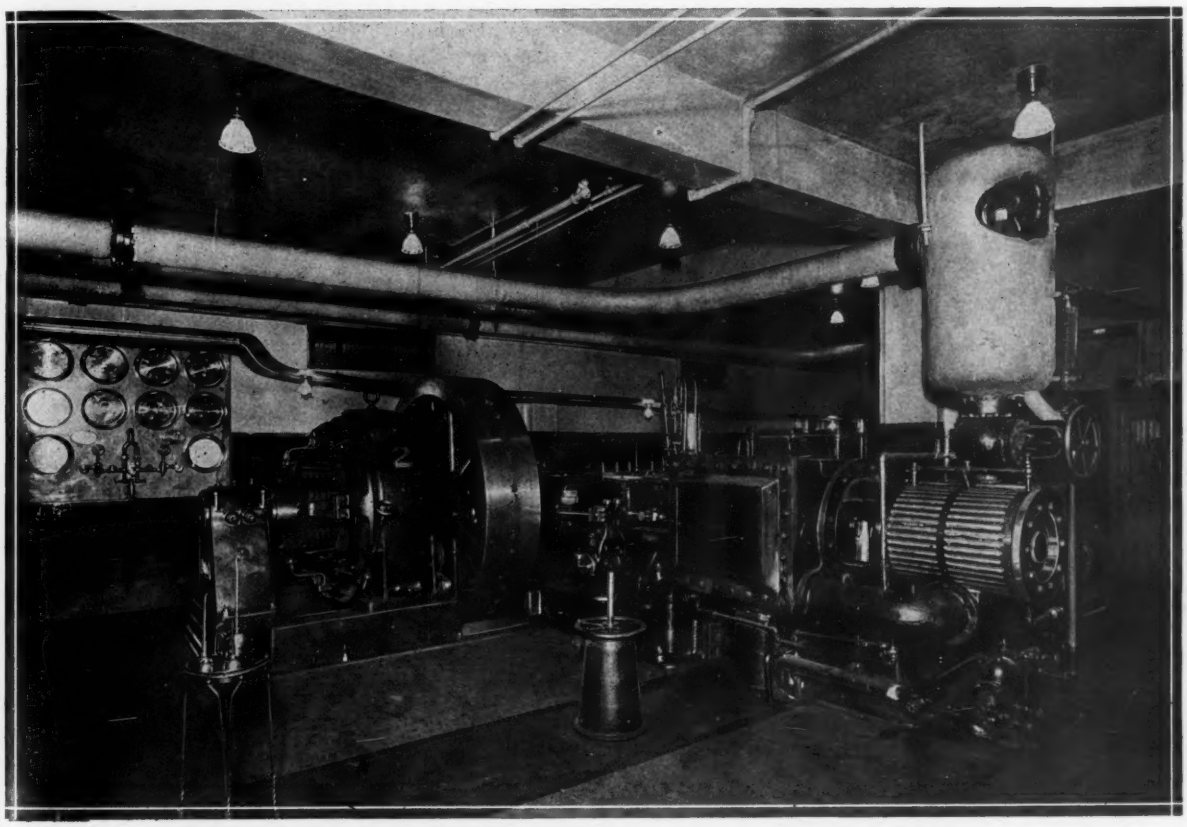


FIG. 1. ONE OF THE 200-KW. GENERATING UNITS AT HOTEL RADISSON

In General

BEFORE ascending to the roof for the start of our inspection, let us get some idea of the building which we are to see and of the magnitude of the work which it represents. The ground space covered is 131 by 170 ft., located on Seventh Street, between Nicollet and Hennepin Avenues, and the building extends 12 stories high at the front and 16 stories

FIG. 2. HOTEL RADISSON AS WE APPROACH IT

at the rear, the depth of the sub-basement below the sidewalk being 24 ft. and the height from the bottom of the footings to the top of the fire walls 200 ft. The building is of reinforced concrete construction throughout, without a wooden floor in it, and is thoroughly fireproof, even the window sash being metal covered, the window glass wire reinforced, and the window sills Tennessee marble.

shower baths. To take care of this water system has necessitated 6 miles of water pipe and the waste is carried away by 7 miles of sewer pipe. In the lighting of the building 5,200 incandescent lamps, varying from 8 to 80 candlepower, largely with Tungsten filaments, have been used, giving a total of more than 100,000 candlepower controlled by 1,300 switches and to carry the current to these and to the fans 50 miles of wire has been strung in 15 miles of iron conduit.

At one's entrance into the lobby, which is finished in white marble and bronze, not only has a homelike atmosphere been found but it has become evident that no expense has been spared to have all equipment throughout the hotel of the best, and our inspection of the mechanical plant will find no exception to this rule. The coat of arms of the hotel is found on all furnishings, being that of the first white man to explore Minnesota, Pierre Esprit Radisson, in honor of whom the hotel is named, and in addition the linen, napery and towels have a border ornamented with the moccasin flower, the state flower of Minnesota.

For the convenience of guests a mail chute runs from all floors of the hotel to the office; also keys to the rooms may be returned by chute without the trouble of going to the desk. For the convenience of the staff a telautograph system is installed whereby directions written by the manager are recorded in the room of the housekeeper or at other points, as may be desired, so that any number of messages may be conveyed from different points to other employes about the hotel and the record left for them when they return. Eighteen stations have been fitted throughout the building for the handling of orders, to and from the kitchen, orders to and from the office and the recording of telegraph and telephone messages for guests.

For hotel purposes the lower 9 floors of the building are used, the 3 upper floors being occupied by the

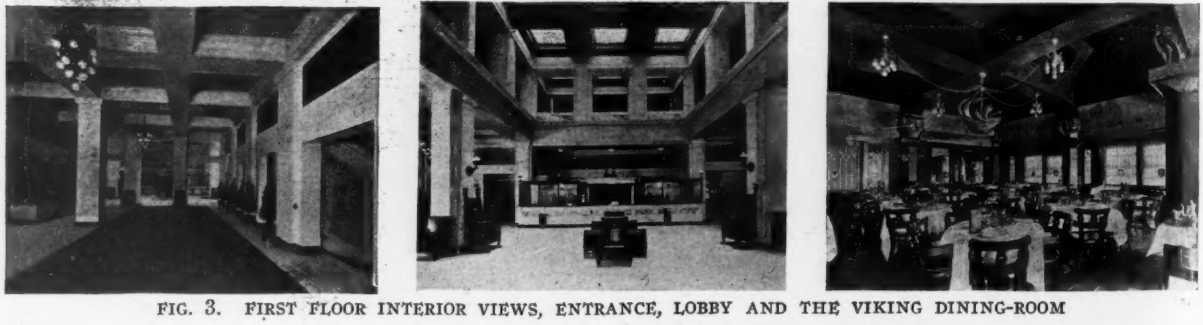


FIG. 3. FIRST FLOOR INTERIOR VIEWS, ENTRANCE, LOBBY AND THE VIKING DINING-ROOM

Doors and casings are the only woodwork about the building, so that fire is practically impossible, but in case there should be a blaze, a complete fire alarm system is provided, consisting of red incandescent lamps burning at convenient points all over the hotel, showing the entrance to fire escapes, and when one of these is smashed by a guest, using a little hammer which hangs alongside, a signal in the engine room shows where the station is, gives the signal to the organized fire corps and releases the fire doors in the corridors which immediately are closed.

Statistics, Water and Light

EVERY one of the 350 guest rooms is provided with hot and cold running water and with circulating ice water, and 75 of the rooms are provided with

Commercial Club of Minneapolis, which club was to a considerable extent responsible for securing the erection of so modern and satisfactory a hotel in the city.

Elevator Service

WHILE light and heat are furnished for both the hotel and the club by a single power plant, the club has its own equipment throughout for ventilating, for dining room service and for the accommodation of its members. The same elevator service takes care, however, of both club and hotel. Going to the roof, we find provision for a future wireless telegraph station, also the fan equipment for the ventilation of the club rooms, and the elevator machines located in pent houses.

These elevators are 7 in number, all electric, 3 of them for passengers only, being of the Otis direct-connected traction type operating at a speed of 500 ft. a minute, and 3 being of the geared type operating at a speed of 250 ft. a minute and used as combined freight and passenger elevators. The 7th elevator travels from the engine room level in the sub-basement through the kitchen to the receiving room and is used for taking care of supplies for the hotel. It is of the electric drum type.

In the traction type the motor is connected directly to the sheaves on which the cables run, and the 6 cables from the car pass directly over the upper sheave down and around an idler sheave, then back over the driving sheave and down to the counterweights, so that 6 ropes are at all times lifting on the car. In the worm gear traction type the same arrangement is followed as to sheaves, but the winding sheave is driven by a worm and intermeshing gears. In all cases the elevators are provided with safety appliances including oil buffers at the bottom, and on the brake wheel, double brakes, either one of which is sufficient to hold the elevator when power is off.

Warm Bathrooms

ON the upper floor is found a large exhaust fan, which draws the hot air and odors from the kitchen and discharges them to the atmosphere; also a special fan for the ventilation of bathrooms. In planning the hotel a novel arrangement of bathrooms is found in that all are inside rooms and are provided with separate heating so that they may be kept warm through the night, even though the sleeping rooms be supplied through the open windows with the coldest of fresh air. To ventilate these inner rooms, an exhaust fan is mounted on the roof which draws from all of them and discharges this air through a stack above the roof.

Also on the 12th floor is found the laundry equipped with 5 washing machines, 2 centrifugal driers, a large mangle and special ironers for body, collars, bosoms, cuffs and ruffles. All these are motor-driven and for the heating of the coils, steam at a pressure of 80 lb. is supplied.

Between the 12th floor and the 4th no mechanical equipment is found other than the signals, lighting systems and temperature regulators which control the heating of the rooms. All rooms are heated with separate radiators and the temperature in each room can be controlled by the person in it through a Johnson hotel type regulator, by means of which the heat can be turned off entirely or the temperature can be held at any point between 60 and 75 degrees.

Lighting Details

THE electric system was planned with the greatest care to produce eye comfort as well as artistic effect. Wherever visible the lamps are frosted or bowl frosted, and in cases of corridor or low ceiling lighting where chandeliers are not available, the lamps are enclosed in frosted globes. The smaller illustrations indicate the different styles of bracket and chandelier lighting used in different parts of the building. The chandeliers and wall fixtures are of bronze of attractive design and carefully placed to give adequate illumination without bringing the lights in direct range of the eye.

A special fixture worthy of note is the central light in the Viking dining room which consists of a model of an old Norse ship, having 28 lights above, 5 lights in the ship and a hull illuminated by a green light to give the effect of waves about the ship.

FIG. 4. IN THE BARBER SHOP, BILLIARD ROOM AND BALL ROOM, SHOWING DIFFERENT LIGHTING METHODS

The ball room fixtures, too, are of unique design, having 30 clear glass lamps surrounded by crystal pendants which diffuse the light so that the entire room is brilliantly illuminated.

An interesting feature of the lighting system is the panel boxes which are made of steel reinfocred with angle iron and have wood fronts steel lined. In these fronts are set push switches controlling the different circuits, and a cover above the switches is removable so that connections can be changed or switches inspected easily.

Wiring is, of course, installed in conduit throughout the building, all wires larger than No. 10 being stranded and all joints made in junction boxes or at outlets.

In the lighting of rooms special care has been taken for the comfort of guests, the dressers being provided with side lights on either side of the mirror, writing tables with portable lamps and overhead lights placed beside the mirror in the bath room. Outlets are also provided in the baseboard to which electric appliances, such as chafing dishes, coffee urns, curling irons and other domestic utensils may be attached.

The Ventilating System

COMING to the 3rd floor we find the room where the mechanical ventilation and heating system is controlled. This is quite compact in arrangement but all is so arranged as to be accessible for inspection and attendance, and the provision for this service is exceptionally complete. Mechanical ventilation is provided for all dining and banquet rooms, lobby, kitchen, barber shop and billiard room. The fan for engine and boiler rooms is located in the basement and that to the toilet rooms, as already men-

tioned, is on the roof. Through the main rooms on the first and second floors the ventilation is provided by means of the plenum air pressure system supplemented by exhaust fans for some of the larger rooms.

Air for these fans is drawn first through a screen and then through tempering coils which heat it to 70 degrees. From these coils the air passes through an Acme air washer made by Thomas & Smith, of Chicago, and arranged so that all the air passes through a double sheet of water spray, thus washing out all impurities and cleaning the air, as well as giving it the desired moisture. Beyond the water spray is a series of baffle plates with the front edges bent backward and the air passing around these is relieved of all surplus moisture so that one may stand in the chamber beyond the baffles while the air is being drawn through the water spray at a rapid rate and not a particle of moisture reaches him.

From this chamber the air is taken by fans to the different rooms and in each duct a tempering coil is placed with thermostatic control from the rooms so that the temperature may be varied as desired. Each tempering coil consists of 2 banks of piping, either one or both of which may be cut out as needed. Provision is also made, if desired, for circulating brine through the main bank of tempering coils so that the air in summer may be cooled. All fans and motors for driving them were supplied by the B. F. Sturtevant Co. and are of the full housed centrifugal type with multivane wheels direct driven by the motors. All ducts are made with long radius bends in the long runs and the plant is installed to avoid any vibration, specifications calling for freedom from vibration with 0.9 ounce pressure on the fans.

The motors are 220-volt direct current shunt wound and are designed to run at 5 per cent above the normal speed by means of a weakened field without sparking. They are controlled by Cutler-Hammer rheostats having 6 running points for the control of speed and a sufficient resistance in series with the armature so that they may be run at 25 per cent below the normal. The coils are of 1-in. pipe set staggered in cast-iron bases 2¾ in. apart on centers and tested to 100 lb. pressure, although the pressure used on the heating system is 3 lb.

Ducts for the system are made of galvanized iron, those up to 24 in. in width being of No. 24, from 25 to 40 in., of No. 22, and 41 in. and over, No. 20; those over 24 in. wide being reinforced by angle irons set 2 ft. 6 in. centers and 1 by 1 by ⅛ in. or heavier. All ducts are supported every 8 ft. or oftener and are painted where necessary.

Fan Motors

THE air washer is cased in with galvanized iron and also has a covering of 1 in. of hair felt and all coil casings and ducts have ½-in. air cell asbestos and are jacketed with heavy canvas. Water for the washer is circulated by means of a 2½-in. centrifugal pump driven by a 3-hp. motor running at 1,025 r.p.m. and the other fans in the installation are driven by motors running from 1 to 30 hp., the largest size being used on the kitchen exhaust fan. The fan for the ballroom is reversible and may be used either as a blast or an exhaust fan by means of reversible dampers.

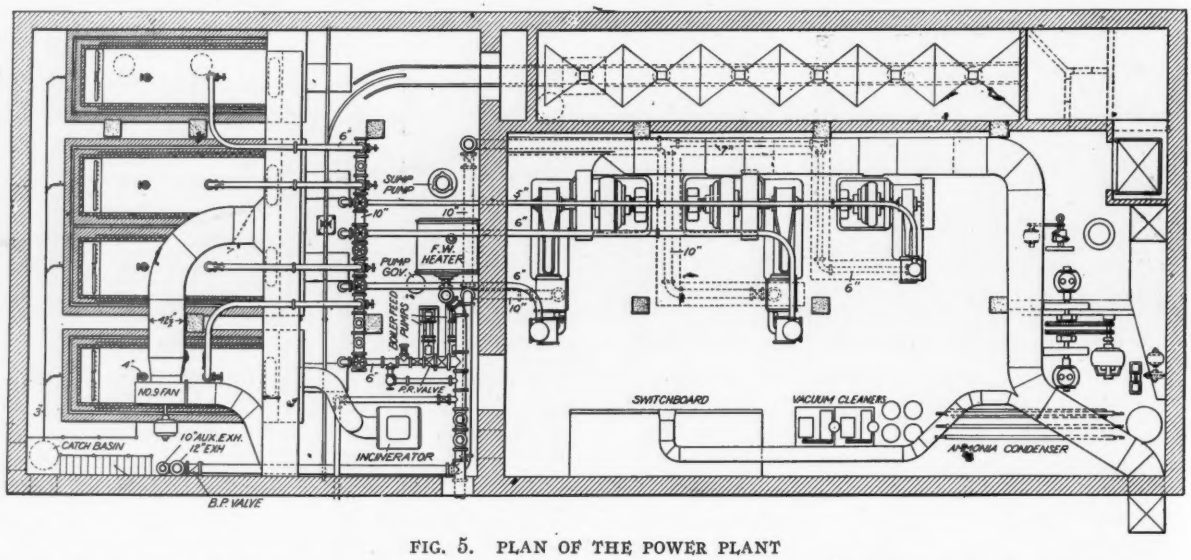


FIG. 5. PLAN OF THE POWER PLANT

All motors are mounted on cork sheets 1 in. thick to take out any vibration and the outlets from fans are connected to the ducts by joints of canvas 5 plies thick, well shellaced together, this joint being about 12 in. in length. The kitchen fan, toilet fans for club and hotel, and the main club ventilating fan, which are located on the roof, are belt driven from Sturtevant motors, Peerless-V belt being used for this purpose.

For heating the coils exhaust steam is used from the engines, supplemented if necessary by live steam passed through a Keiley reducing valve and the condensation from coils and radiators is drawn off by a Paul System apparatus located on the gage board in the engine room, the air being released from radiators by means of Marsh-Paul automatic air valves. The pipes of the heating system are covered with 85 per cent magnesia covering having a 6-oz. canvas jacket painted 2 coats and the fittings covered with plastic magnesia cement of equal insulating value.

Air pressure for the Johnson service is furnished by a duplex pump, an air pressure of 25 lb. being maintained in a receiver bank and reduced to 11 lb. for use on the system. The action of the pump is controlled by the air pressure in the system, which

opens or closes a valve in the steam pipe leading to the pump, as may be necessary.

To Keep Cool

WHILE hot air and ventilation are necessary to keep humanity fresh, the same treatment will not result in durability for foods and it becomes necessary, therefor, to provide refrigeration for the edibles as well as for the cooling drinks so grateful to the overheated mortal, and following Dante's progress from the regions of heat to those of intense cold, we find next in our trip through the building the refrigerating rooms located on the kitchen floor. The

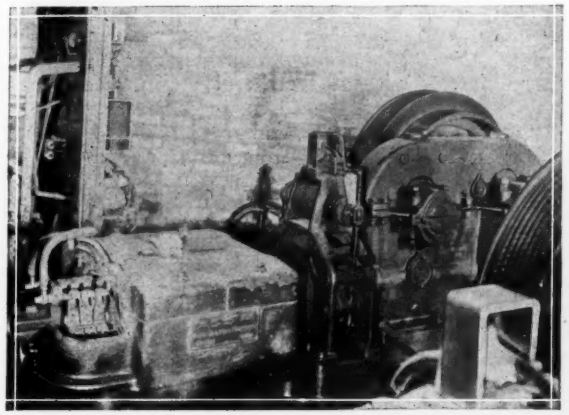


FIG. 7.- ONE OF THE TRACTION ELEVATOR MACHINES

plant which supplies these with juice will be found when we reach the sub-basement where the twin giants make their home, but the useful function of the refrigerating plant is located here among surroundings that whet one's appetite to the point of distraction.

Here in the kitchen, which continuous scrubbing and the use of the vacuum cleaner keeps spotless and which has 8,500 sq. ft. of Stonewood flooring tile and walls of white glazed tile, are located rooms for the preservation of meats, poultry, vegetables, milk, oysters, butter and eggs, bakers' materials, fish, and frozen pastries, together with smaller store rooms from which service is made direct to the restaurant.

Brine System

ALL these are cooled by brine coils through which the brine circulates from a tank located on the roof. This tank is 4 ft. in diameter by 5 ft. high, made of ¼-in. steel and has a capacity of 1,000 gallons. It is placed in an insulated room built of concrete and is supplied by pumps in the engine room which take the brine from the brine cooler and force it upward. From this brine tank the circulation is by gravity to the coils in the various refrigerating rooms, a charge of 10,000 lb. of calcium chloride being necessary to give the brine for the first charge.

Cooling Rooms

THESE rooms are cooled to temperatures ranging from 28 to 36 deg., and all are built with heavy insulated walls and floor. The composition of this insulation is of interest as showing the best of modern fireproof construction. For the brine house on the roof a hollow tile wall is used on which is placed ½ in. of Portland cement. While this is wet a 2-in. course of Acme cork is attached to it, then another ½-in. layer of Portland cement and a second course of Acme cork is attached by galvanized nails to the first course, extending through the cement layer, then 2 ¼-in. courses of Portland cement are put on inside of the cork.

Insulation of the cold storage rooms is the same as for the brine tank room. A 3-in. hollow tile and 2 layers of insulation, either 3 in. plus 2 in., or 2 in. plus 2 in., with cement layers between. For the partitions in the refrigerators the layers are made 2 in. plus 2 in. of Nonpareil cork with a Portland cement layer between and on the outsides, and 2 coats of cold water paint over the Portland Cement.

Floors are made of Portland cement covered with ½ in. of hot asphalt, then 3 in. of cork, ¼ in. hot asphalt and 2 in. of cork, the final finish for these floors being galvanized iron pans. Ceilings are made of asphalt ½ in., then cork 2 in., asphalt ¼ in., 2 in.

FIG. 8. AMMONIA COMPRESSORS, BRINE PUMP AND CONDENSER COILS

more of cork and then 2 ¼-in. coats of Portland cement. Doors to the refrigerating rooms are 6 in. thick having oak outsides and cypress or spruce backs with 4 in. of granulated cork between. The door frames are of oak trimmed with tinned hinges and fasteners and the sills are of angle or channel iron.

By this construction not only is complete insulation of the storage rooms secured but durability and cleanliness are obtained.

In the installation of the brine piping Nonpareil cork covering was used, to prevent absorption of heat by the brine. The coils in the cold storage rooms are in duplicate while in the individual refrigerators for serving rooms the coils are single. Another refrigeration feature is the ice water system, which is piped to all rooms. This water is cooled by a tank located in the engine room and the water is circulated by means of a centrifugal pump which sends it to the roof whence it flows downward through drop pipes with short horizontal connections to the faucets. The mains are 1¼-in. pipe, 700 ft. being installed, while the risers have 7,250 ft.

In the insulation of the ice water system, which runs to the 10th floor then drops to the second and goes by a circulating header to the refrigeration tank,

the cork covering is 1.47 in. thick for the 1-in. pipe, 1.48 in. for the 1¼-in. pipe, 1.42 in. for the 1½-in. pipe, 1.47 for the 2-in. pipe. This covering is Johns-Manville Nonpareil and has the joints made in asphalt pressed tight and bound with copper wire 1 ft. apart. On the outside a coat of asphalt paint is placed.

This covering is applied on the main risers and the main piping on the 10th floor and in the engine room. On the drop risers which run through the partitions 2 ½-in. thicknesses of Keasbey & Mattison Alaska brine covering are used with broken joints and a 5½-oz. canvas jacket. The joints are stapled at 3 in. apart and the whole is covered with Alaska brine paint, the fittings being covered with Alaska brine putty of a thickness equal to the pipe covering and then given a canvas jacket. The circulation pipe is galvanized iron, and after being put in place was swabbed out and hot water circulated through it one week to cleanse it of all foreign matter.

For cooling the water we find installed in the engine room a tank 6 ft. in diameter by 7 ft. high, made out of ¼-in. steel enameled inside and having Nonpareil cork insulation on the outside. This has brine coils distributed through it which cool the water. And here we find ourselves in one end of the engine room proper, ready to investigate the chief quarters of the steam and electrical machinery.

Refrigerating Machinery

BY the side of this cooling tank we find located a Gould's centrifugal pump driven by a Perfection 2-hp. motor made by the Northwestern Electrical Equipment Co., Minneapolis, and as a relay to this a duplex pump which is connected for the same service as the centrifugal. Water comes from the roof tank, to which it is pumped by a Luitweiler deep well pump from the 700-ft. artesian well, through the cooling tank and is sent to the house system at a pressure of 85 lb. Here in the corner with the cold water system we find, naturally located the brine cooler, ammonia compressors, condenser coil and brine pumps. In designing the plant it was decided that separate brine systems would be needed for ice-cream making and storage and for the refrigerators, first because the ice-cream coils must be kept at a lower temperature than those for storage, second, because the ice-cream service is irregular.

Compressors

PARTLY for this reason and partly for the sake of evening up the pull on the driving motor the compressor capacity was installed in 2 units of 18 tons each, supplied by the Larsen & Baker Co., of Omaha. These are driven by a Western Electric motor 55 hp., which runs 575 revolutions per minute and is connected to the compressors by a silent chain drive. Each compressor has 2 single acting pistons and at first the 2 compressors were connected quartering, but it was found that there was some difficulty keeping the driving chains running smoothly with this arrangement so that the compressors were changed to run in synchronism and they are now running that way—quietly. As a rule the compressors are run about 16 hr. a day, getting the brine down to zero and then are left standing for approximately 4 hr. during which the brine will rise to 20 deg; it is never let to get above 22 deg.

Heavy flywheels are used on the compressors in order to prevent flickering of the lights, because these compressors are motor-driven from the same generator which furnishes current for the lighting system. The regulation of the engines is so sensitive, however, that no flicker can be detected, even by the most careful watching. The compressors are 8½ in. in diameter by 12 in. stroke, single acting with 2 pistons to a compressor. The cylinders are of semi-steel capable of withstanding 500 lb. pressure and the valves and seats are of tool steel, the shaft 4⅞ in. in diameter, the flywheels 5 ft. in diameter and weighing 3,000 lb. each, while the sprocket for the chain drive on each compressor weighs 1,000 lb. The Renold silent chain drive used on the compressors is 1½-in. by 4 in. and drives from pinions on the motor 8.63 in. in diameter with 18 teeth and 1½-in. pitch gears on the compressor shafts 54 in. in diameter with 114 teeth. The rating of the compressors is 18 tons of ice each for 24 hours or 13 tons of refrigeration in 18 hours.

The brine cooler is of the shell type of the Carbondale make, of 30 tons capacity and brine is pumped through this by either an Aldrich triplex pump which is motor driven by means of a noiseless chain from a General Electric 10-hp. motor or a Gardner duplex brine pump.

Ammonia Condenser

AMMONIA is sent through the condenser coils and then allowed to expand into the brine cooler, direct ammonia expansion being used also in the ice-cream section of the refrigerating plant. The brine through this ice-cream section is circulated in a separate system and is kept at a lower temperature than the brine for the refrigerators.

The condenser is double piped in 3 sections, 20½ ft. long by 12 pipes high, made out of 1¼ and 2-in. pipe, and is provided with ammonia receiver, oil separator and scale trap. The system requires for a charge 350 lb. of ammonia.

Expansion coils are cooled by water from the city mains which is sent around these and then to a tank in the boiler room, from which it is pumped to a roof tank and used for washing.

Modern Sweeping

THE answer to this is, "There isn't any." For the old fashioned broom and carpet sweeper have no place in a strictly up-to-date modern hotel. Even the maid's ubiquitous feather duster has disappeared from the scene and instead of flicking you playfully with it as you pass by, she is more likely to tangle you up in 50 ft. of wire wound air hose or drop the extension dust brush pipe on the top of your newly bought derby.

Nevertheless, peace to the ashes of the dust brush for the modern way actually cleans things and it is quite possible to sit down on an upholstered chair in a vacuum cleaned room without arousing from its slumber a cloud of dust which has been innocently disturbed by your activity. Here again the engineer comes to the fore and instead of human muscle we have the giant Electricity to do our hard labor.

Throughout the building are placed the air pipes leading downward to a vacuum cleaner installation at one side of the refrigerating plant and to the outlets of this system may be attached brushes and lengths of hose with all kinds of nozzles fitted for cleaning all

sorts of articles, with exception of the teeth and finger nails, and while the former operation is still a personal one, the lady manicurist in the basement will fix up the latter for you, but not by the vacuum process.

The vacuum system, which was installed by the American Air Cleaning Co., of Milwaukee, consists of a duplex automatic set each unit capable of carrying 3 sweepers. In case 3 sweepers or less are at work only one unit is in operation, but if a fourth sweeper be attached to the system, the second motor unit automatically starts up and runs as long as there are 4 or more in operation. Each unit is driven by a Western Electric 7.5 hp. motor by means of a silent chain, the automatic solenoid for cutting in the extra motor being arranged on a switchboard furnished by the Cutler-Hammer Company.

Vacuum of 10 in. is maintained on the system and the dust and dirt are drawn to collectors in the basement which strain out all the collected refuse and this is removed from the collectors frequently. Relief valves are provided to prevent a vacuum of over 10 in. being formed in the system. The exhaust air is blown to the stack and passes upward through the roof. For making connections to the outlets there were furnished by the American Metal Hose Co. 600 ft. of aluminum hose 15/16-in. inside diameter with smooth bore hose couplings and able to carry 25 in. vacuum.

Automatic Time Savers

OTHER auxiliary systems used in the conduct of the hotel are the waiters' signals, by which a waiter in any of the dining rooms is informed that his order is ready for service in the kitchen, the signal for each waiter being a different number surrounded by an outline of different color, one waiter having the number 2 inside a square, another 3 inside a circle, another 4 within a diamond, and so on, and each of these being of different colored glass so that they can be easily distinguished across the room.

The room service signal is also a great convenience to guests as well as to management. When entering the room a maid plugs into a small socket located at one side of the door in the corridor and this lights a signal lamp over the door and at the same time lights a corresponding lamp in the manager's office, showing that the room is being put in order. Also the time during which the lamp at the manager's desk is lighted shows the time spent in arranging a room as well as keeping track of where the maids may be found at any time.

An automatic dish conveyor operating on the principle of an endless chain or band runs continuously from the serving room to the dish-washing end of the kitchen, and thus much heavy work which ordinarily falls upon the servants is eliminated. Furthermore, the bugbear of dish washing is mechanically performed, but don't let your wife know this for the washer there installed is not suitable for home consumption and the old method must for a short time yet prevail in our numerous individual family hotels.

Water Supply

THE supply of water for drinking and cooking is furnished from an artesian well 700 ft. deep, from which is drawn by a Luitweiler deep well pump 7 by 15 in. and having a capacity of 200 gal. per minute against 245 ft. head at 40 revolutions. The barrel is located 40 ft. below the ground although the water rises to within about 8 ft. of the surface. A 25-hp. motor is used to drive this pump. For forcing the city water to the roof after it has passed the ammonia condenser, a duplex pump 10 by 6 by 10 in., with brass plunger and rods and brass lined cylinder, is installed, also a Worthington turbine pump driven by a 10-hp. motor with Cutler-Hammer starter. This motor is controlled by means of a 5-in. float valve and float switch located in the pent house on the roof which encloses the water tanks, but the motor may also be controlled by a switch in the engine room. The deep well pump is also controlled by an automatic starter from the roof tank which is driven by a 20-hp. Western Electric tank. This deep well pumping apparatus and also

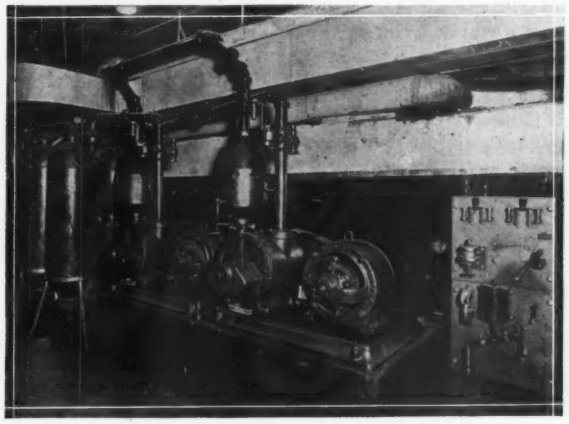


FIG. 9. THE VACUUM CLEANER

the service pumps for the house are located on a mezzanine floor in the boiler room, and while we are here we may as well look over the rest of the boiler room apparatus.

Exhaust Steam Disposal

ON this same mezzanine floor is found the Baldwin oil extractor which has 14-in. inlet and outlet for steam and a 2-in. flange connection at the bottom for drainage, also a float valve to let oil into the sewer. This is a steel shell 6 ft. 6 in. long by 6 ft. diameter, provided with baffles and an oil dam with overflow and gage glass to show the height of the water in the separator.

In the boiler room below the extractor is placed the Webster Star vacuum heater to which the main heating returns are connected by 5-in. pipe, and with 4-in. vapor outlet. There are 4 main lines of heating returns coming into a 6-in. header and with American District Steam Co.'s condensation meters and traps applied on each 4-in. line. The condensed steam is carried into the heater. The object of measuring the condensed steam on the different return lines is so that proper charge may be made to each department for the amount of steam used in keeping track of the up-keep expenses, also the steam for heating the Commercial Club's quarters is supplied from the boiler room and a 3-in. return pipe from this system is also metered. A 2-in. cold water connection is made to the heater so that make-up water may be supplied as necessary.

(Continued on page 776.)

POINTERS ON PUMPS

SUCTION PIPES

By C. F. Swingle

THE size of the suction pipe should be so proportioned that the velocity of flow will not exceed 200 ft. per minute. This applies in cases where the length of pipe does not exceed 25 ft., with not more than 2 elbows and 2 valves.

For lengths longer than 25 ft. the velocity decreases with increase in length of pipe as follows:

50 ft.....velocity 180 ft. per min.
100 ft.....velocity 150 ft. per min.
150 ft.....velocity 125 ft. per min.

For size of pipe, first find area in sq. in. from which the diameter can be calculated: Area equals area of water cylinder in square inches times piston speed in feet divided by 200 if pipe is not more than 25 ft. in length. If longer, substitute for the divisor, either one of the velocities given above, according to the length of the pipe.

When the velocity of water is doubled, the friction is increased 4 times; if trebled friction is increased 9 times.

For pumping hot water, arrange the pump so that the water can flow into it.

Slip and Pressure Ratios

PUMP slip or slippage denotes the difference between the calculated and the actual discharge of the pump. Slippage increases with increase of speed, and rules for ascertaining slip are as follows:

Per cent of slip=cube root of piston speed in feet per minute×discharge pressure÷600.

For slip and leakage: Per cent of loss=cube root of piston speed in feet per minute×discharge pressure ÷180. For hot water substitute 100.

Steam pressure required for a pump when taking water under pressure=delivery pressure—suction pressure×area of water piston÷area of steam piston.

Water pressure against which a pump can work when raising water by suction=area of steam piston× steam pressure÷area of water piston. From this should be deducted suction lift in feet÷2.3.

Direct acting pumps are generally operated at low speeds, and as the parts are light, and the momentum low, it is generally all absorbed in friction.

The ratios of pressures in a pump are found as follows:

Ratio of water pressure to steam pressure=area of steam piston÷area of water piston.

Ratio of steam pressure to water pressure=area of water piston÷area of steam piston.

Pump Troubles

WHEN one side of a duplex pump works faster than the other during each stroke, it indicates either that the rod packing on the slow side is causing excessive friction, or that the packing on the water piston of the fast side is badly worn, and allows the water to leak past the piston.

If the speed of a pump gradually increases from day to day, while the volume of water delivered by it remains the same, the piston packing in the water end will be found to be giving out, and needs renewal.

When a pump fails to lift water after having been idle for some time, the trouble will generally be found in the water piston packing, and the suction valves, these parts having become too dry to be air tight.

Priming the pump, viz.: filling the water end with water, and immediately starting the pump will usually remedy the trouble.

Sometimes a leak will occur in the suction pipe. In case the pump cannot be made to work by priming, first examine the suction pipe and its several valves for leaks. If there is a foot valve on the suction pipe and the pipe loses its water when the pump is stopped, it indicates either that the foot valve leaks, or else that there is a leak in the pipe somewhere and this can usually be detected by filling the pipe with water and then examining it throughout its length. If no leak can be discovered in the pipe or valves above the level of the water source, then the foot valve is leaking.

Stoppage of the suction pipe, or a failure of the supply is indicated by a jerky action of the pistons, and if the suction is entirely stopped, the pump will gradually slow down, requiring a high steam pressure to produce a slow motion.

Pumps taking water under pressure should have a valve in the suction pipe for regulating the flow of water into the suction chamber.

Operating a Broken Duplex

IF one side of a duplex pump becomes disabled from any cause, as breaking of piston rod in the water cylinder for instance, which is liable to happen, the pump may still be operated in the following manner until duplicate parts to replace the broken ones have been secured. Loosen the nuts, or tappets on the valve stem of the broken side and place them far enough apart so that the steam valve will be moved through only a portion of its stroke, thereby admitting only steam enough to move the empty steam piston and rod, and thus work the steam valve of the remaining side. The packing on the broken side should be screwed up tightly, so as to create as much friction as possible; there being no resistance in the water end. In this way the pump may be operated for several days or weeks and thus prevent a shut down.

Setting Valves of a Duplex

TO set the steam valves of a duplex pump proceed as follows: Place both pistons exactly at midstroke. This may be done in 2 ways; first, by dropping a plummet line alongside the levers connecting the rock shafts with the spools on the piston rods, then bring the rods to the position where the centers of the spools will be in a vertical line with the centers of the rock shafts.

The second method is to move the piston to the extreme end of the stroke until it comes in contact with the cylinder head. Then mark the rod at the face of the stuffing box gland. Next move the piston at the other end of the stroke and mark the rod at the opposite gland. Now make a mark on the rod exactly half way between the 2 outside marks and move the piston back until the middle mark is at the face of the gland and the piston will be at midstroke.

Having placed both pistons at midstroke remove the valve chest covers and adjust the valves in their central position, viz.: so that they cover the steam ports.

The valve rods being in position and connected to the rocker arm by means of the short link, the nut,

or nuts securing the valve to the rod should be so adjusted as to be equidistant from the lugs on the valve, say 3/32 or 1/8 in. according to the amount of lost motion desired which latter factor governs the length of stroke in some makes of duplex pumps, while in others it is controlled by means of tappets on the valve rod outside of the valve chest.

Care should be taken when making these adjustments that the valve be retained exactly in its central position.

Having set the valves correctly, move one of the pistons far enough from midstroke to get a small opening of the steam port on the opposite side then replace the valve chest covers and the pump will be ready to run.

As these valves are generally made without any outside lap, a slight movement of one of the pistons in either direction from its central position will suffice to uncover one of the ports on the other cylinder sufficiently to start the pump.

WATER SUPPLY PUMPS AND WELLS

By J. O. Benefiel

IN many parts of the country the water question is a live problem to the engineer and steam user, especially if the line of work requires any considerable quantity. In my present position we started with a 6-in. well 50 ft. deep and a demand for about 100 gal. a minute. We could get only 60 gal. a minute from the well which necessitated running the pump at night and storing the water for the next day's use, the pump was a duplex, lifting by suction about 20 ft. The first day I was on the job I worked on the pump until 11 o'clock that night thinking the reason we did not get more water was because the pump was out of order.

Young engineers are likely to think that the great quantity of air they get when the pump has a high suction lift or the flow is not free, indicates a leaky suction when such is not the case, the air being liberated from the water under the high vacuum.

Our demand for water increasing, we went about 400 ft. from the shop and dug some holes about 10 ft. deep in the swampy ground and got quite a quantity of surface water; this supply lasting until a county ditch drained this low ground.

We then drilled our 50-ft. well down to 100 ft., getting a fair flow. In this well a brass cylinder was secured at a depth of 40 ft. by means of a rubber packer using a steam head to work the plunger. A deep well pump of this kind works well when in order and the water is free from grit, but the leathers generally have to be renewed often which is a job the engineer dreads.

Then after a time the brass tubing, of which the cylinder is made, wears through and in not more than 1 case out of 6 can the cylinder be loosened and taken out. The sediment apparently packs it until it might as well be a part of the casing.

In this well we set the first cylinder in the casing or drive pipe, wore it out and failed to get it loose. We then pulled the check valve, set another cylinder and when it wore through, the cup leathers on the plunger turned over and wedged so tightly we could not get the plunger out. We then had 2 cylinders, check and plunger in an otherwise good well. It looked like the well was ruined but we did not quite lose out. We put a brass cylinder on the end of a 4½-in. pipe, dropped it down 35 ft. and drew a fair amount of water through the old stuff already in the well.

But right here was where we quit fastening anything in the casing, we always attach our cylinders, where such are used, to a drop pipe even in a house well, in this way there is practically no danger of loosing a well. I have had only 1 casing to rust out, this was due to the ground near the well becoming saturated with sulphuric acid.

When this happened we tried to pull the casing and it parted a short distance below the surface, we moved over 2 in., drilled another well good for 120 gal. a minute at the same depth. Moved the rig 20 ft.

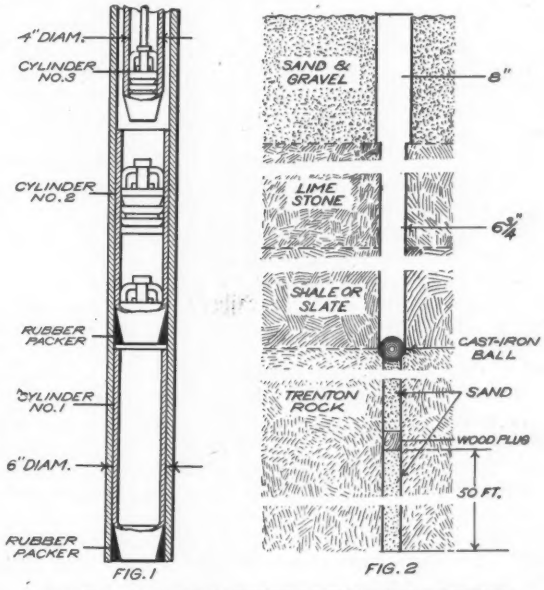


FIG. 1. ARRANGEMENT OF CYLINDERS IN WELL.
FIG. 2. DEEP WELL FOR GAS AND METHOD OF PLUGGING

away and drilled 8 ft. deeper and got a dry hole, no sign of a water bearing stratum. When it was filled with water it would hold like a jug.

I could account for this only on the hypothesis that the good well was in the bed of a long buried river while the dry hole was on the bank.

Our next well venture was not for water but gas, with water as a secondary consideration. In drilling a deep hole, the hole is usually drilled, in this section, for 8-in. pipe to limestone, when the driving shoe reaches the stone it is driven down, on or into the stone hard enough to shut off the water from above, no more 8-in. pipe is used. The drilling is continued through the limestone, which may be 50 to 500 ft. thick, and usually has water between its layers, after passing through the limestone into the shale or slate a 6¼ or 5⅝-in. casing of lighter pipe with a fine thread is put in the hole and driven to a water tight joint, from this point to the Trenton rock no water is found.

In the Trenton rock natural gas, oil, or salt water is usually found, sometimes a dry hole, that is, neither of the 3 mentioned.

In our case we found a little gas and much salt-water, the latter we had no use for so it was concluded to plug the well below the limestone and use it for water.

The plugging which is required by law is done by dumping gravel or sand in to the depth of 50 ft.,

on top of this a wooden plug is driven, more gravel is dumped in up to the point where the 6¼-in. casing is seated, on this seat a cast-iron ball is dropped. This seals off the Trenton rock, keeping the salt water below and the fresh water above.

In the limestone we may get a soft water that will not scale a boiler or a water that contains considerable scale making impurities.

I used to wonder why drillers did not use wire drill ropes but when I asked one of them the answer was so simple I felt ashamed, it's the spring or elasticity of the fiber rope that gives force to the blow, a rope with no elasticity would hit but a feeble blow.

Our next hole in the ground was a 10-in., 300 ft. deep, this proved to be a good waterwell having a capacity of 300 gal. a minute. With a deep well pump 7½ by 36-in. water cylinder we could get 150 gal. a minute. When the time came that we needed more water we bought a second hand air compressor and doubled the output with the air lift. With this supply we went along fairly comfortably for a year or so when the demand again began to exceed the supply. About this time an enthusiastic salesman came along with another kind of a pump which he guaranteed would increase the output from the 10-in. well from 300 to 500 or 700 gal. a minute, it looked good so at much trouble and expense we rigged up a drive for him. This was what he called an impeller pump, we had 120 ft. of shaft in the hole with something like a screw propeller every 42 in. We did not get 700 gal. nor 500, it was still a 300-gal. well.

I believe, however, the impeller type of lift will get more water out of a hole than anything else if you have the water, have seen them throwing 1100 gal. a minute from 10-in. wells but the water was there in abundance.

Our next venture on this well was to drop an extra 1-in. air pipe down in this well. This was a rank failure the pipe inside the discharge seemed to retard the flow. This has convinced me that the air pipe inside the discharge pipe is poor practice, in spite of the fact that you can pull your air pipe without disturbing your heavy discharge pipe it sometimes happens that your air discharge will choke up with oil from the compressor and scales and dirt from the pipe, and it is a great convenience to be able to pull the small air pipe without disturbing anything else.

As a general proposition, water that has to be lifted from a depth of over 100 ft. is expensive. Both the air and impeller pump work at their greatest economy at 100 ft. or less and a submergence of 60 per cent, that is, 60 ft. of water in the well to 40 ft. of discharge above the water. The air lift is practically a failure with a submergence of 40 per cent or less until someone gets up a direct displacement pump that will work in a 6 or 8-in. casing.

In a rock well, that is, one drilled into the stone, the gravel, sand, clay and water from the upper strata are shut off and no screen is necessary, but where the water is drawn from the gravel or sand a screen of some sort must be used. Generally a brass screen is used but I have had good results when using 10 ft. of pipe on the lower end of the casing drilled full of ¼-in. holes equal to about twice the area of the pipe. This has an advantage in fairly coarse gravel of letting the finer particles pump out and surrounding the point with coarse free gravel.

THE CHIEF ENGINEER will frequently find himself equally in doubt with regard to his difficulties and the methods proposed by friends to remedy them.

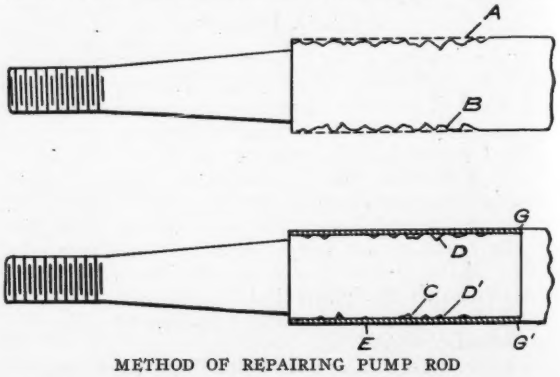
FEED PUMP ROD REPAIR

By C. W. DUNLAP

I WOULD like very much to shake hands with Brother James Browning of Chicago, who some time ago submitted the article pertaining to the repairs of a much worn main rod on a 6 by 4 by 6 in. feed pump. I have been in much the same boat many times, and I know of several others that are handicapped in the same manner.

It was only a few weeks ago that I visited a small steam plant not far from where I am employed, and while in the engine room the engineer was having a heart-to-heart talk with the superintendent about some new rods that the engineer claimed he needed for the feed pumps. "I don't see why the rods don't last longer than 6 months," said the superintendent. "Over at so and so's they only buy a new set every 14 months."

"That may be very true," put in the engineer, "but the conditions are different there and here. Over there they pump cold water from the street mains through an enclosed heater to the boiler, and here we pump water taken from an open heater, at no time



METHOD OF REPAIRING PUMP ROD

with a temperature lower than 200 deg. F. and nearly all the time above 208 deg. F., and to shorten up the matter, the hot water attacks the steel of the rod and in a very short time deteriorates it, especially where the rod has no contact with bearing surfaces, of the glands or packing."

The writer at this juncture ventured to say that, if the superintendent would leave it to him and the engineer, he thought the matter could be fixed up and the old rods used all right. To this the superintendent radily agreed, as any of them will when they realize that little or no expense is to be attached to the repair or whatever it may be.

"Let me see," said I, "your plant operates condensing; what size tubes have you in the condenser?"

"They are 1-in. external diameter, but I don't know their thickness of gage." "That don't matter, just get out about 12 in. of one of them, then remove the pump rods, have them turned off where pitted and corroded, to the driving fit size of the bore of the tube."

In the accompanying sketch at B is shown about how the rod looked when removed from the pump. The dotted line A is intended to represent the original size of the rod before pitting took place. At E is shown the brass tube after having been driven on the rod; it will be noticed at D and D′ that the turning did not clear up the entire rod; this however did not make any difference with the fit.

The rod was beveled in as is shown at G and G′ so as to admit a like bevel on the piece of tubing. After smooth filing this joint at G it was impossible to tell where the 2 pieces the rod F and the brass tube section E came together, other than there is a considerable difference in the color of the brass and the steel metals.

The entire cost, besides the engineer's time for this repair, was 60 cents, which was for the lathe work of turning off the rods. It is plainly seen that sometimes the little things about the engine room, if given some time and attention, bring forth a lot of good results. Some skeptical person may say, why didn't this engineer use an all bronze rod? That's easily answered, this particular superintendent was looking out to get down the first cost, without figuring in the life of the rod.

THE BLAZER SPIRAL PUMP

THIS consists of 2 impellers working in synchronism in intersecting bores of a casing which carries a support containing a pair of steel cut gears. Shafts which connect these gears extend through bronze bearings to a pair of interlocking spirals or impellers, and rest on ball bearings which are of sufficient strength to carry the water load of the pump. From the working head a tube extends downward and carries the pump in suspension. The working head carries the driving shaft and acts as an oil reservoir, thus giving perfect lubrication.

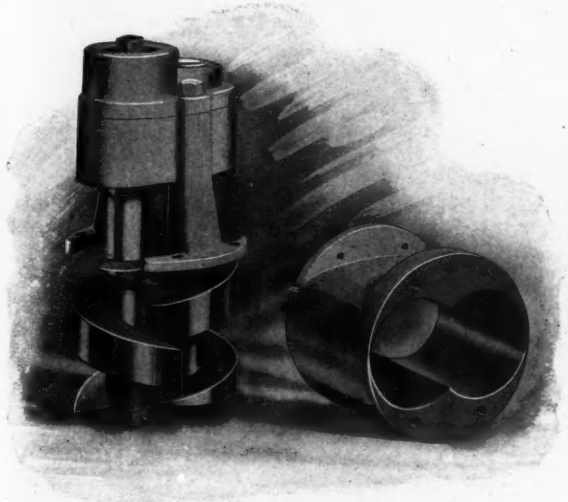


FIG. 2. BLAZER IMPELLERS AND CASING

Figure 1 shows the pump assembled and ready for work as driven by a direct-connected electric motor. Water by action of the spiral impellers is drawn upward and forced through the casing into the outlet which extends at right angles to the vertical tube. Figure 2 shows the working parts of an 8-in. Blazer pump dismounted. This has impellers with 4-in. pitch, these being designed for high lift and small volume. For a lower lift with larger volume the pitch of the impellers is increased.

In using the Blazer pump all necessity for frame work for holding the pump and driving mechanism is eliminated. An expansion flange seals the pump in position and the simplicity avoids operating difficulties. The pump is made in capacities of 50 gal. a minute up to 3000 gal. a minute, the 50 to 150-gal. pump being made to fit a 6-in. well casing, 100 to 250 and 200 to 500 for an 8-in. casing, 200 to 1000 for a 12-in., and 500 to 3000 for 16-in. If desired the pump can be arranged with a vertical motor, thus doing away with the bevel gears. The Blazer pump is made by the Humphreys Mfg. Co., of Mansfield, Ohio.

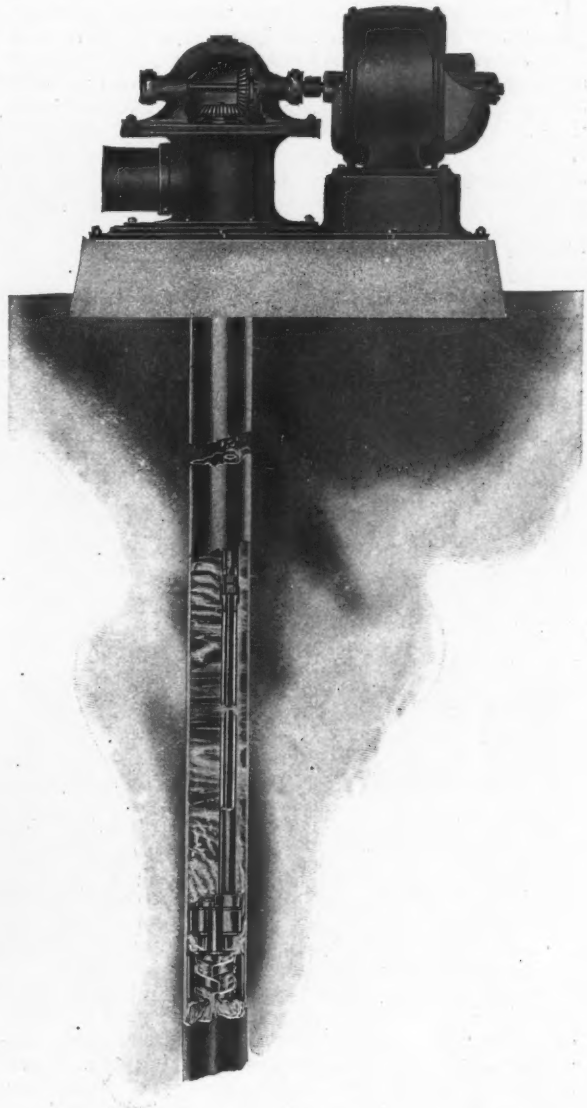


FIG. 1. BLAZER SPIRAL PUMP AS INSTALLED

A STATIONARY CONVERTER

SMITH, erecting temporary electric lines across the mill yard, put them up in great haste and they were very zig-zagged.

Reagan, looking along the lines: "Say, Smith, what current are those lines for?"

Smith: "For direct current. Why?"

Reagan: "Well, bejabbers, it'll be alternatin' when it reaches the other end of those lines."

THE SULTANA

By Drummond O. Scott

THAT which has been called "The Great Mystery"—the blowing up of the Sultana—occurred a few miles above Memphis, in that portion of the Mississippi river known to steamboatmen as the fatal zone of Island 40, on account of the number and character of the wrecks that had occurred there.

In the following article, based on the statements of an officer of the boat and several passengers, we propose to show that there was no mystery, and that under the existing conditions and circumstances the disaster was unavoidable.

The Sultana en route to St. Louis from New Orleans landed at Vicksburg, late in the evening of April 21, 1865. Her crew consisted of 85 men, and she had on board 25 passengers, among them several married couples with children, and one newly married pair, Mr. and Mrs. S. W. Harden of Chicago. Her cargo was light, principally sugar, and included several horses which were stowed together on the starboard guard.

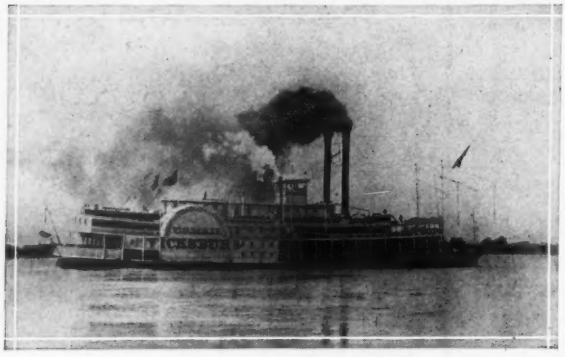


FIG. 1. THE VICKSBURG WHICH IS SIMILAR IN ALL RESPECTS TO THE SULTANA

Her boilers were leaking, one of them so badly that a new quarter sheet was required in order to put it in serviceable condition, while a few girth seam rivets, here and there, on the others, and the calking of all the flue ends in the rear heads were deemed necessary, before she could continue her journey. These repairs required considerable time, and while they were under way the boat was boarded by 1966 soldiers, including 36 officers.

These were returning prisoners of war, the bulk of them from Andersonville, among whom were the remnant of those who had been captured at Chickamauga and Gettysburg—an emaciated hollow-eyed lot, basking in the sunshine and tasting the air of freedom for the first time in years—and they were happy as children as they staggered or were carried aboard.

The staterooms not already occupied by the passengers or reserved for the officers, were filled with the sick, while long lines of cots took up the available space in the cabin, and were spread out on the main deck, occupying every foot of space on the hurricane roof.

The boat was a veritable living hive of men, and when after all repairs had been completed she swung out into the stream about 9 o'clock on the morning of the 24th, the proper distribution of the load in order to preserve a perfect balance, and keep her on an even keel, became a question of the first importance.

In common with all river steamboats the Sultana had two mud drums under her boilers, one front and one rear, connected to each boiler on the bottom by large necks or riveted pipes. In addition to these there were what was known as chalk joints, these being open flanged connections, 6 to 8 in. in diameter between, and riveted to the boilers at the fire line near the front ends. This arrangement made it possible for the water to pass from one boiler to another rapidly and in case the boat was listed, that is to say, down on one side or the other, the water could run to the lower boiler as freely almost as to the low side of a tilted pan.

By keeping this fact in mind, as we describe a few of the succeeding details, we shall be able to dispense with all mystery in connection with this, the greatest life destroying explosion of steam boilers that ever occurred.

On account of their previous suffering and present condition, the restless soldiers were allowed the widest liberty of action that their cramped quarters permitted, and they were continually moving about; any unusual sight on either shore was the signal for a general rush to that side of the boat, causing a list of the vessel which, if prolonged, would be sure to result disastrously.

The army officers had been told of this and for a time preserved order and kept the men to their allotted places, but finally relaxed their vigilance, and the duty fell upon the officers of the boat, which, as may be supposed, caused friction between the crew and the soldiers, the latter resenting any attempt to curtail their liberty, thinking, no doubt, that their past suffering among enemies was sufficient, without being held in bond and kept under constraint by their friends.

The chief engineer, fully aware of the situation and conscious of the fact that the officers of the boat were powerless to command, even in an emergency, became alarmed at the frequency of the lists and prepared as best he could, to avert the danger. He ordered the hot water hose to be coupled up, and stationed men at the nozzle, and others in position to lighten up and shift the body of it from place to place, as he might direct. He then went along the guards, and in the deck room, telling the men of the danger of crowding to either side, of the preparations he had made, and that he had authority to use the hose, and warned them to move and move quickly whenever he gave the order to do so; while he knew that all the men on the lower deck, if gathered to one side, were in nowise a counterbalance for those on the two upper decks, yet they would assist in preventing a dangerous list.

Had the system, thus inaugurated, been in vogue on the two upper decks, the boat would have made her voyage in safety, but unfortunately, this was not the case, the soldiers being left to wander about at will, crowding across decks at every cry of something new to look at and escaping the threatened danger, only because the objects of interest were about evenly divided between the two shores. The boat was thus, being continually listed from side to side, and the

engineer and his assistants were kept busy at all times except when the soldiers were asleep.

She landed at Memphis, about 9 p. m. on the 26th, where several passengers got off and an equal number came on board. The clerk's register after this exchange showed 24 passengers, 1966 soldiers and officers, and 85 of the crew, making 2075 souls on board. After discharging a portion of her cargo, enough coal was taken on to run to Cairo. To this fact is due in a great measure the disaster that followed. The noise and excitement of unloading and coaling up had aroused every one. The hoarse cries of the mates, the songs and banter of the half-clad negroes as they threaded the narrow stage planks in the glare of the pine torches, the "Heave Ho!" in the deck room and the rattle of the empty coal boxes on the bottom of the coal barge had driven all thoughts of sleep away, and when the work was completed and she swung out into the stream the human hive had become a restless moving mass.

The little town of Hope, Arkansas, a short distance above and still in sight of Memphis, gave the engineer renewed cause for alarm. The faint lights of this place caused a rush to the port side, that tilted the boat so far over that the buckets of the starboard wheel almost cleared the water. The possibility of turning over so frightened the soldiers on the upper decks that they ran back of their own accord and for the time prevented a dangerous list. This incident, while it increased the restlessness of the soldiers, did not prevent its recurrence, and any light, however faint, or distant, continued to attract attention.

She was now entering the haunted water of Island 40, and whether a presentiment, founded on the previous occurrences on board actuated the engineers, or whether it was a precaution, due to a belief in the hoodoo power of the Island, certain it is that the speed of the pump was greatly increased, and the boilers were pumped up, until the water level, if taken on an even keel, would have been found only a few inches from the tops of the shells. The assistant engineer was trying the water at the time, and even while the gage stick was pressed against the upper gage cock of the starboard boiler, the boat was felt to careen suddenly to port, and so far over that steam spurted out of the second and bottom gage cocks, when he tried them. The thump of the starboard engine, as the wheel was lifted, almost clear of the water, caused him to drop the gage stick and run to the footbox, where, on account of the extra list, he found it necessary to shut off all steam from that engine.

The port wheel was buried nearly to the shaft in the water, and the engine on that side was straining pitman and connections in its efforts to turn it over. The hosemen bewildered at the suddenness with which the boat went over, and frightened at seeing the water appear over the outer side of the guard stood with blanched faces, making no effort to trim her up, while the soldiers on the lower deck in terror ran and crawled to the opposite side of their own accord. The horses, restless from the time of leaving Memphis, broke their fastenings and attempted to jump over the bull gates that closed them in: a universal panic succeeded. Orders were unheeded, discipline forgotten and the engineer knowing that no power on earth could prevent a disastrous explosion, if the boat remained longer in her present position, ran to the middle of the deck room and gave a hurried glance along the line of water gages. His heart sank within him as he noted that the gage needles of the starboard boilers pointed straight downward and that steam was issuing from the upper flanges of the steam drum necks. At the same time a surging in the steam pipe over his head, and a groaning in the port cylinder, told him plainer than words that the water from the boilers was now passing over to that engine.

His first thought on seeing the position of the water needles was to order the fires drawn—then it became necessary to shut down the port engine. It seemed as if hours had elapsed since the water left the outer boilers. He felt that the shells were red hot from the fierce fires that were burning under them and that plate and seam were already stretching out to the bursting point, and he knew that when the water ran back into them again the sudden increase of pressure would tear them to atoms.

While he stood undecided, he felt the boat righting itself, not gradually and steadily as would have been natural in such a case, but with a sudden short,

FIG. 2. TYPICAL RIVER FRONT SCENE AT MEMPHIS

jerky motion, that caused the decks above and beneath him to tremble and crack as if their planking and beams were being wrenched apart. Almost paralyzed with fear he turned and ran to his footbox as fast as his trembling limbs would carry him and ascended the steps.

As he faced about a sound like the hissing of a huge snake, followed immediately by a thunderous report and accompanied by a rush of steam and hot water, stunned and blinded him for a moment and when he opened his eyes in the awful pandemonium that ensued he stood half stifled and alone on the footbox.

The whole upper works from the boilers aft, except the wheelhouses and a portion of the ladies' cabin were blown away. The stacks toppled over, carrying pilot houses, texas and the midsection of the boiler deck with them, the whole crashing down together, crushing and mangling hundreds who were pinned between decks, while those on the hurricane roof were hurled to their death in the water below.

Sheets of flame from the furnaces shot upward and igniting the splintered timbers ran aft, with the speed of thought, winding the whole after portion of the boat at once in a seething whirl of fire.

The port wheel, sunk to its shaft, was kept rolling slowly over by the force of the current. The bulkhead and a portion of the bakeshop behind the engineer had been blown away and as the wild cries of the burning victims sounded in his ears, and the flames surged up to and around him, he turned and jumped into the water just forward of the wheel and passed under it, clinging to one of the buckets. On rising to the surface his head came in contact with a long

wooden ladder, to which he and some others, equally fortunate, clung until it became entangled in a clump of young trees growing in the water, a little distance from the Arkansas shore.

From this position he saw the burning wheelhouses fall outward, and the last remnant of the upper works, at the rear, disappear in the flames, and, most terrible of all, he saw the head of the boat turn down stream.

The wind had been blowing toward the stern, and all forward of the fire room had escaped the flames. Fully five hundred people were huddled together on the unburned upper deck and forecastle. Now as the boat swung around the fire with added fury ate into this last refuge and the closing scene was, if possible, more horrible than the beginning.

As the fire advanced, scores fell or were pushed overboard. A life boat was thrown, bottom up, from the hurricane roof and crashed down on the heads of those below, drowning many more than it rescued. Husbands tied life preservers to their wives and children and pushed them over into the struggling mass; doors and shutters were torn off and the maddened men fought for possession as they fell into the drowning throng; heavy stage planks and bales of hay were thrown into the water, only to sink with those they fell upon and rise too far away to be of service.

The flames were now leaping forward to the jackstaff, forming a canopy of fire and smoke above the doomed people, and when the last supporting stanchion burned away the remnant of the upper deck fell forward on to the crowded forecastle, and the last living soul on board perished.

Inside of forty minutes from the time of the explosion the drifting hull was a mass of twisted iron and smoking timbers.

Over 1400 perished outright, and many of the rescued afterward died of their wounds.

The only mystery in the case is the cause that impelled the men, at that ghastly hour in the morning, to congregate so suddenly on one side of the vessel.

A TALL CHIMNEY

DETAILS OF CONSTRUCTION AND LIGHTNING PROTECTION

By Walter B. Snow

AT Chicopee, Mass., the Dwight Mfg. Co. has recently completed the erection of a new chimney of about 7000 boiler hp. capacity, which will furnish draft for the present boiler equipment and for future boilers to be installed, and will take the place of the present induced draft apparatus. It is 250 ft. high above the top of the foundation, has a flue 12 ft. in diameter and consists of an outer shell containing a core built of common red brick. The foundation is of concrete and rests upon a ledge of rock at a depth of about 30 ft. below the boiler room floor level. It is 40 ft. square at the bottom, the sides being battered so that the top is 28 ft. square. The total weight of the chimney and foundation is about 4500 tons so that the weight per square foot on the supporting rock is slightly less than 3 tons, a most conservative figure.

Shell

FOR a height of 40 ft. 6 in. the shell is straight and of octagonal section, being 26 ft. from face to face. At this point there is a stone water table and above this point the external shell has a circular cross section. The bottom diameter of this section is 24 ft. 9 in. while it tapers with a batter of 5/16 in. per foot to a diameter of 15 ft. 8 in. at a point 33 ft. from the top. It then remains straight for a distance of 10 ft. while in the last 21 ft. it flares to a diameter of 18 ft. there being a vertical section 2.5 ft. high before reaching the cast-iron cap.

The thickness of the shell wall beginning at the foundation is as follows: The first 40 ft. 6 in. is 32 in. thick; the next 50 ft. additional is 24 in. thick; the next 50 ft. additional is 20 in. thick; the next 50 ft. additional is 16 in. thick; the next 57 ft. 6 in. additional is 12 in. thick.

Core and Connections

THICKNESS of the core wall is as follows: Sixty-six ft. 6 in. is 20 in.; 60 ft. additional is 16 in.; 60 ft. additional is 12 in.; 63 ft. 6 in. additional is 8 in.

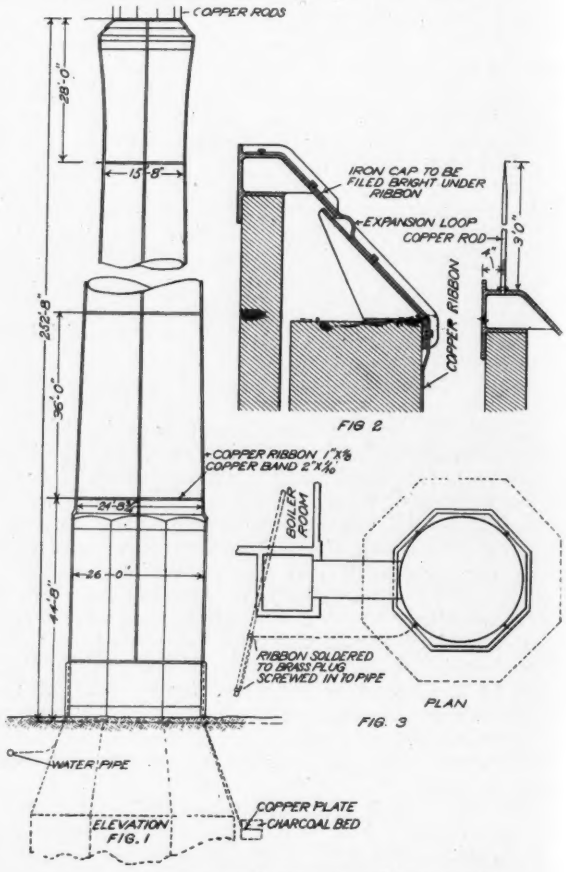


FIG. 1. ELEVATION OF DWIGHT CO'S. CHIMNEY
FIG. 2. DETAIL OF CHIMNEY CAP AND LIGHTNING CONDUCTOR CONNECTION
FIG. 3. PLAN OF CHIMNEY AND LOCATION

The breeching to the power house is 17 ft. by 7 ft., entering one face of the octagonal section 15.5 ft. above the foundation. Over the flue opening the chimney is supported on a cast-iron lintel and reinforced with 8 8-in. 18-lb. I beams set in the brick work. In the first circular section the external shell is reinforced by 4 bands of 3.5 in. by 2.5 in. by ⅜-in. angles, set in the brick work and spaced 10 ft. apart.

A cleanout door is provided 3.5 ft. above the foundation and directly under the breeching, there

being a roadway passing between the chimney and the powerhouse under the breeching. The bottom of the chimney up to the cleanout door is filled with gravel topped with 4 in. of concrete.

Lightning Guards

THE problem of lightning protection presented some very interesting features to Mr. Main, the designing engineer. Ten ¾-in. copper rods are screwed firmly into holes tapped at equal distances around the top into the cast-iron cap, which is made in 2 parts, one set on the external shell and the other on the internal shell, which extends 12 in. higher than the outer one.

Ground conductors are 4 in number and consist of ⅛-in. by 1-in. copper ribbons, spaced equidistant

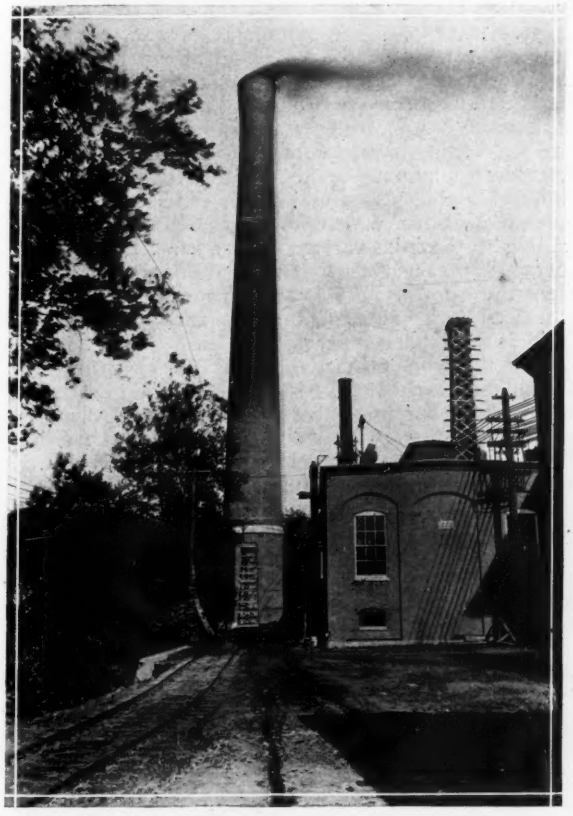


FIG. 4. VIEW OF COMPLETED CHIMNEY AND CONSTRUCTION WORK

around the chimney. Each one of these is attached to the cast-iron cap by 4 ½-in. composition tap bolts, the cap being filled smooth under each band and a 2-in. expansion loop being provided between the inner and outer caps.

Conductors are attached to the brickwork by ⅛-in. by 1-in. copper clamps every 4 ft., which are nailed with 2 3-in. copper nails to composition plugs set in the bricks. The conductors are free to slip behind the clamps and a 2-in. expansion loop is provided every 100 ft. Every 36 ft. a 1/16 by 2-in. copper band extends entirely around the chimney and is connected to the vertical ribbons by 2 ¼-in. copper rivets, the joining edges being chamfered and tightly soldered. Joints in the bands and in the ribbons are made with 4 ¼-in. copper rivets, the edges being chamfered and soldered as above.

At the base 3 of the copper ribbons are buried about 20 ft. in the ground, the end of each being securely riveted and soldered to a 16-gage copper plate 2.5 ft. by 5 ft. which is buried in a 2-ft. layer of charcoal or crushed coke about pea size. This will prevent any oxidation of the plate or ribbon and its consequent disintegration. The fourth conductor is led to a water main and soldered in 2 places to brass plugs screwed into separate lengths of pipe. For a distance of 10 ft. above the ground the ribbons are protected by a grooved plank securely spiked to the brickwork.

All the brickwork was laid from the outside staging as it was considered that the masons could work with a greater degree of speed, safety and comfort and produce a much better looking job than when laying overhand from the inside.

The chimney and the lightning protection system were designed and the erection supervised by Charles T. Main, of Boston, Mass.

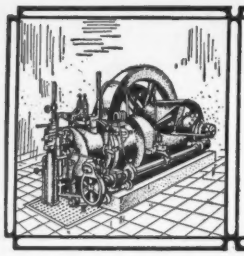
VARIED POWER USES IN A SMALL PLANT

AN installation of considerable interest for the varied use to which the power is put, is the plant of the railroad repair shops of the New York Central Lines at West Albany, N. Y. Electric current, both alternating and direct, is used for lighting and power to a considerable extent. For transmission from the power house to the various parts of the shops the current, which is generated at 480 volts, 3-phase 60-cycle, is stepped up to 2300 volts, and at each shop stepped down through transformers for operating the induction motors. Arc lights in the yards are on the alternating-current circuit, while to provide direct current for incandescent lighting and about 40 per cent of the motor load there is a direct-current service at 250 volts generated by 3 motor generator sets.

Compressed air to the extent of 95,000,000 cu. ft. per month is furnished at an average pressure of 90 lb. per sq. in. by 2 Ingersoll-Rand 360-hp. compressors, this service being used for operating pneumatic tools, boiler tube cleaners, and for testing air brake equipments, and various other uses. Hydraulic power is also used to a large extent principally for pipe testing and similar uses and to supply the necessary amount of water under pressure, a three million gallon service pump is provided.

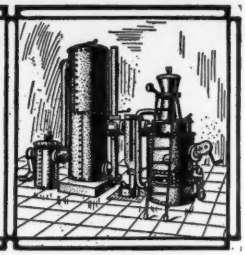
Uninterrupted operation and ability to meet sudden demands are the essentials necessary in a plant providing such service and therefore the boiler equipment was most carefully considered in the design of this station. The original equipment consisted of 4 500-hp. Franklin water-tube boilers equipped with Taylor Gravity Underfeed Stokers, manufactured by the American Ship Windlass Co. Later when the station was enlarged, to the boiler equipment was added a battery of 3 600-hp. Edge Moor water-tube boilers, and these were also equipped with Taylor Stokers. The large overload capacity and steady operation possible with these stokers dictated their choice for this plant.

TO FIND THE RESISTANCE of a cable whose size is given in circular mils, drop 1 cypher from the number of circular mils and the result will be the number of feet per ohm.



Gas Power Apparatus

Producers, Engines and Industrial Applications



LONDON LETTER

TWO-CYCLE REVERSIBLE MARINE OIL ENGINE

By W. A. Tookey

PECULIAR features of the ordinary Diesel oil engine are familiar to all engineers. The method of ignition of the charges and the simplicity of the governing device enable this type of engine to yield good results with almost any kind of liquid fuel and this being so it would seem to be particularly suitable for use on freight and pleasure vessels.

But in common with other types of internal combustion engines, experience has shown that the 4-cycle principle is not ideal for marine service owing to the 3 inoperative strokes of the cycle of operations. With

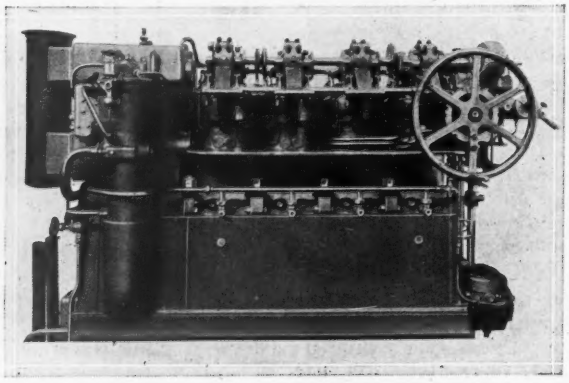


FIG. 1. DIESEL REVERSIBLE MARINE OIL ENGINE

a 4-cylinder engine only 2 impulses can be given to the cranks per revolution and, although this frequency may well suffice for ordinary speeds, it has been found impracticable to rely upon for satisfactory operation when the exigencies of marine service require slow rotation of the propeller shaft.

A further disadvantage of the 4-cycle principle is in relation to the necessity of reversing—the relative timing of the inlet, exhaust and fuel injection valves requiring somewhat complicated mechanism which, while ingenious, seldom embodies any other valuable characteristic. It is for this reason that the European makers of the Diesel engine have attacked the special problems to be surmounted before a reliable and simple motor can be produced for the successful operation by more or less unskilled attention usually available upon a craft of moderate dimensions.

Principle of Operation

THE result of the special investigation is shown in the accompanying drawings and it will be seen that a very compact and comparatively simple engine has been evolved. The 2-cycle principle has been adopted, each of the 4 cylinders being fitted with a long piston which at the extremity of the down stroke discloses a ring of exhaust ports through which the burnt products of the working charge are expelled. Such expulsion is aided by a blast of air from a separate scavenging pump placed at one end of the motor cylinders and in a line therewith. This scavenging pump is double acting and forces pure air into a cylindrical chamber which forms an induction passage leading to the inlet valves. There are 2 mechanically operated inlet valves to each cylinder and through these the scavenging charge is forced simultaneously at a pressure of about 3 lb. per square inch.

This pressure suffices to obtain complete expulsion of the former charge and, as the piston returns, the ring of exhaust ports is covered and the imprisoned air is compressed within the small clearance space to a pressure of about 450 lb. per square inch. Two or three degrees before the piston reaches its inmost position, the fuel injection valve opens and the combustion of the charge follows in the usual way.

With this arrangement each cylinder gives an impulse to the crank at every revolution and therefore from the 4 cylinders an impulse is obtained 4 times during the 1 revolution.

Construction

CYLINDERS are separate castings supported by means of strong pillars from a common base casting which accommodates the main bearings. The cylinders are also connected one to the other by means of flanges and bolts giving lateral stability while the pillars are also provided with diagonal struts. In the half tone illustration it will be seen that side plates are fitted so that, in effect, the engine is totally enclosed but these plates can be readily removed when the whole of the crank chamber is at once exposed for the purpose of inspection or for the adjustment of the bearings, etc.

The injection of the fuel is arranged in the manner usually adopted with engines of this type A separate oil pump is provided for each cylinder and the desired quantity of fuel is forced into the annular space around the injection valve proper, from whence it is forced into the cylinder by means of compressed air at a pressure considerably above that prevailing in the motor cylinders. This high-pressure blast forces the oil through a series of perforated disks which act as atomizers and thus the fuel reaches the cylinder in the form of a fine spray or mist in which condition it is readily ignited by the heat of compression.

The high-pressure air is obtained by means of a

2-stage compressor shown in the drawing adjacent to the scavenging pump and at the extreme right of the sectional elevation. Not only does this compressor supply the necessary air for the fuel injection, but also for the compressed air receivers brought into use when first the engine is started from cold. No preliminary heating is required of any portion of the engine and therefore a start can be made at extremely short notice. Indeed in a series of trips made in a vessel fitted with an engine of 100 hp. only a few seconds elapsed between the moment that the engineer stepped on board and the moving of the vessel under oil from the landing stage.

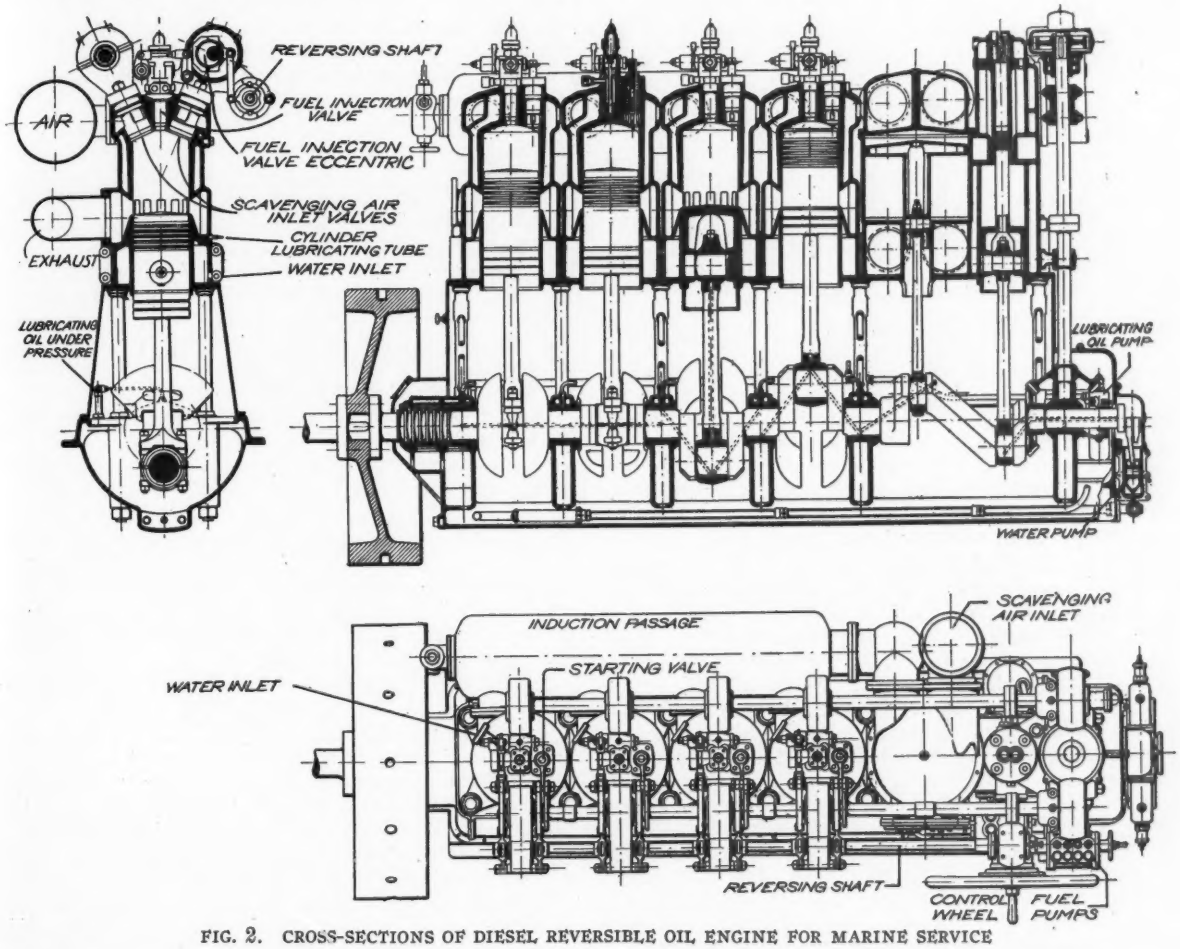


FIG. 2. CROSS-SECTIONS OF DIESEL REVERSIBLE OIL ENGINE FOR MARINE SERVICE

Valve Operation

IT will be seen from the drawings that all the valves are located in the crown of the cylinders and that there are 4 valves to each. Two of these are scavenging air inlet valves placed at an angle with the vertical center line of the engine. These valves being opened once every revolution—when the ring of exhaust ports has been disclosed—require no special timing device and are therefore worked directly from the 2 shafts passing along the top of the cylinder. Centrally above the center of the cylinder the injection valve is placed and on 1 side, midway around the crown and between the main inlet valves, the compressed air starting valve is situated.

The process of starting consists in opening the compressed air valve and setting the fuel regulating valve to the predetermined position. Then all is ready and, at the word of command from the skipper of the vessel, a slight rotary movement of the starting and controlling wheel, which also is the reversing wheel, forces open the starting valve in that cylinder within which the piston is nearest the top in the proper position for the rotation of the crank in the desired direction. After a few revolutions under compressed air the fuel pumps charge the connecting pipes with oil and, ignition ensuing, the engine begins to pick up speed. The compressed air is then shut off.

Reversing and Controlling Mechanism

A PROMINENT feature of the engine is the large hand wheel shown in the half tone illustration. It will be observed that it is fitted with a spring locking device which engages with a series of notches placed at varying intervals round the periphery of a fixed disk. In the position shown the engine is set for full speed ahead the maximum effective movement of the fuel pump plungers being then obtained. Rotation in a clockwise direction would permit the locking device to engage in the next notch which would give 3-quarter speed. Further movement in the same direction would cut off the supply of oil a little more so that half speed would result. Similarly still further rotation would so reduce the supply of fuel that the engine would go dead slow, and by bringing the hand wheel a little further the suction valves of the oil pump would be held open so that no

fuel at all would enter the cylinder and the engine would thus be brought to rest.

Still continuing the clockwise rotation of the hand wheel the position of the eccentrics fitted to the inlet valve shaft controlling the operation of the injection valves would be varied in the movement afterwards to be explained and by such movement the oil would be injected into that cylinder ready to receive it according to the position of its piston so that an earlier injection into the compressed cylinder contents would take place. Then the combustion ensuing would force out the piston in the reverse direction of rotation of the engine and, all injection valves being controlled from the same shaft, each cylinder would receive its charge of fuel at such time that the reverse direction of rotation should be maintained.

The engine thus being reversed without recourse to clutches, or even to compressed air would run dead slow owing to the fact that in this position the smallest effective motion of the pump plungers are taking place. For increased speed further rotation of the hand wheel still in the clockwise direction is required when quarter, half, 3-quarter and full speed are obtained at the will of the engineer without other controlling device.

For stopping, the hand wheel is brought back to the central position from which partial rotation to the right or left will restart the engine ahead or astern as may be desired. It will be recognized that no simpler method of control could be expected or desired and that in this device very considerable improvements are to be recognized over other methods that have hitherto been looked upon as unavoidable inconveniences of a motor boat.

The hand wheel is connected to a trip rod which holds the suction valves of the fuel pumps open for a varying period of their stroke according to the power to be exerted, in a similar manner to the method of governing adopted in connection with the ordinary stationary Diesel engine. A second connection is made by means of gear wheels to a shaft which runs parallel with the overhead valve shaft, the eccentrics upon the latter which operate the injection valves being anchored to a ring surrounding the third —reversing shaft. This ring is itself anchored to a projection from the bearings of the third shaft. The gear wheels connected to the hand controlling wheel cause this third shaft to rotate and for the greater portion of such rotation no effect is produced, the rings to which the injection valve eccentrics are anchored remaining in the same relative position.

But it will be noticed from the transverse section that a specially shaped cam is fitted to the third shaft which has a projection separated by 180 degrees from a similar depression. It will also be observed that the ring encircling the cam is fitted with 2 inwardly projecting portions and these are so placed that when the nose of the cam has been rotated through nearly 90 degrees from the position shown in the section, these inwardly projecting portions are encountered, the hollow part of the inner cam permitting a corresponding movement of the ring which has up to this time been rigidly held in position. Thus the ring is either pushed upwards or downwards, varying the time of contact of the eccentric with the roller on the starting valve lever. It is in this way that the compressed air is injected at the proper moment to ensure reversal of the engine in the desired direction, the effect being that the angle of the eccentric strap during such movement of the anchoring ring is caused to strike against the starting valve roller and thus to inject compressed air, although at the moment the engine itself is at a standstill.

Fuel Supply Adjustment

AS with the stationary Diesel engine almost any kind of liquid fuel may be supplied with equally satisfactory results with no other preparation or adjustment than the regulation of quantity provided for by means of a separate control valve. This once set to suit the fuel in use requires no further attention to be given at any speed of the engine. In order to obtain the requisite fine adjustment a ratchet wheel with fine teeth is fitted and the lever is provided with a spring locking device similar to that used in connection with the starting wheel.

Two single acting plunger pumps worked from a disk crank at the extreme end of the main crank shaft are used for water circulation. Each of the 4 working cylinders are water jacketed as also the 2-stage air compressor.

There are 6 main bearings in all. Four are placed between the cranks and, of the 2 outer bearings, that next the flywheel is designed as a thrust block, while the cover of the other forms the footstep for the vertical shaft giving motion to the 2 valve shafts at the top of the cylinders. Each of the 4 main cranks are counterbalanced and with the 4 impulses per revolution it will be recognized that a very regular turning effort is obtained.

Adjacent to the water pumps is placed the lubricating oil pump which draws the oil from the bottom of the crank chamber through 2 filters, one on each separate suction pipe, and delivers the lubricant to all the main bearings under pressure. Suitable holes are drilled in the crankshaft to conduct the oil to the crank pin bearings and from these to the piston pin brasses through holes drilled throughout the connecting rods.

Some little difference in design occurs with respect to the position of the oil fuel pumps. In the plan accompanying, these are shown to the right and just behind the hand wheel. In the half tone it will be seen that 2 eccentrics are placed in pairs along the overhead valve motion shafts. The former is the position preferred by Messrs. Sulzer of Winterthur.

In order to appreciate the advantages of a motor of this description it may be mentioned that a vessel of 60 tons displacement capable of carrying 200 passengers and equipped with a 70-hp. steam power installation with coal for a trip of 75 miles would require machinery and equipment weighing altogether about 14 tons. A 2-cycle Diesel engine of the type described, capable of giving 150 hp., complete with fuel sufficient for a radius of 750 miles would weigh about 9.5 tons and require only 50 per cent of the space.

The following table gives the results of 3 trial trips from which the cost of operation can readily be calculated for the duty there specified:

Trial No.	1	2	3
Speed, miles per hr.....	12.25	12.50	11.75
Distance traveled, miles	14.90	14.90	6.15
Time occupied, min.	73.00	71.27	31.60
Fuel consumed, lb.	84.00	92.50	23.00
Fuel, per mile, lb.	5.64	6.20	3.75
Average r.p.m. of screw 300.00		310.90	259.00
I.hp. 172.00		189.00	112.00
Fuel per i.hp. per hr.....	0.385	0.40	0.375

VARYING IGNITION POINT IN PRODUCER GAS ENGINES

By C. C. Austin

A MANUFACTURER of producer gas engines usually tells the purchaser the best point in the stroke at which to ignite the charge of gas, and shows him how to vary the point of ignition within certain limits, but neither the purchaser nor the engineer is told why this is the best point of ignition. The purpose of this article is to show the

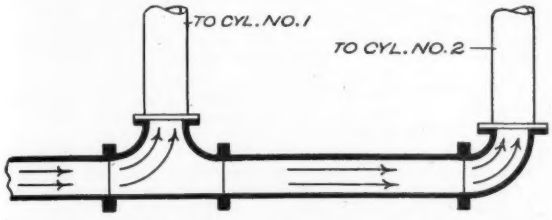


FIG. 1. POSITION OF CYLINDERS WITH REFERENCE TO INTAKE MANIFOLD

effect of varying the point of ignition in producer gas engines and discuss the practical difficulties encountered when the spark position exceeds certain well defined limits.

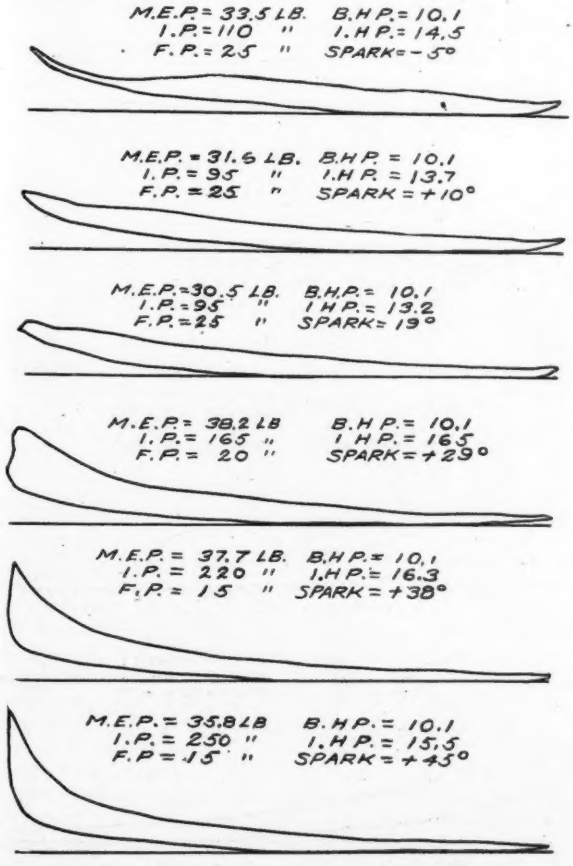

M.E.P. = 33.5 LB. B.H.P. = 10.1
I.P. = 110 " I.H.P. = 14.5
F.P. = 25 " SPARK = −5°
M.E.P. = 31.6 LB. B.H.P. = 10.1
I.P. = 95 " I.H.P. = 13.7
F.P. = 25 " SPARK = +10°
M.E.P. = 30.5 LB. B.H.P. = 10.1
I.P. = 95 " I.H.P. = 13.2
F.P. = 25 " SPARK = 19°
M.E.P. = 38.2 LB B.H.P. = 10.1
I.P. = 165 " I.H.P. = 16.5
F.P. = 20 " SPARK = +29°
M.E.P. = 37.7 LB. B.H.P. = 10.1
I.P. = 220 " I.H.P. = 16.3
F.P. = 15 " SPARK = +38°
M.E.P. = 35.8 LB B.H.P. = 10.1
I.P. = 250 " I.H.P. = 15.5
F.P. = 15 " SPARK = +45°

FIG. 2. CARDS TAKEN WITH LOAD OF 20 HP.

The engine on which these tests were made is a 43 hp., twin cylinder, upright, single acting, 4-cycle, throttling governed, producer gas engine, manufactured by the Fairbanks-Morse Co., and located in the gas engine laboratory at Purdue University, LaFayette, Ind. The cylinders are 11 by 12 in., and the engine runs at 300 r.p.m. It is equipped with a prony brake so that the load can be easily changed. Loads of 20, 27, 34 and 43 hp. were put on the engine and 6 cards on each cylinder taken at varying points of ignition. On cylinder No. 1, these points were 2 degrees late or 2 degrees after the piston had passed the inner dead center, and 12, 20, 32, 38 and 45 degrees early or before the piston had reached the inner

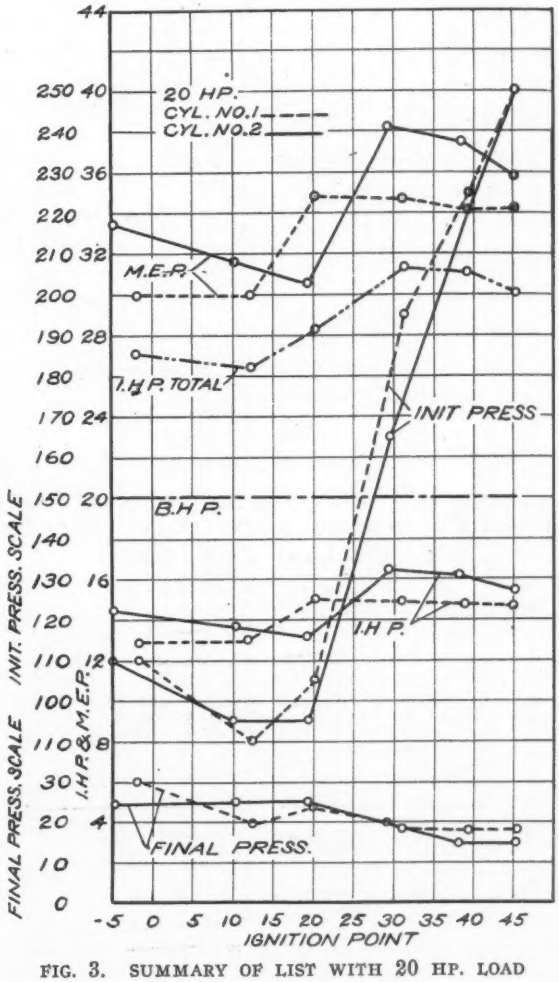


FIG. 3. SUMMARY OF LIST WITH 20 HP. LOAD

dead center; on cylinder No. 2, these points are 5 degrees late, and 10, 18, 28, 38 and 45 degrees early. The position of the cylinders with reference to the intake manifold is shown in Fig. 1. It will be seen from this that the inertia of the gas tends to carry it on past No. 1 and into No. 2; consequently the initial pressures and mean effective pressures are higher on No. 2 than on No. 1, because it gets a heavier charge. It may be remarked in passing that engine manufacturers can well afford to take a lesson from the manufacturers of automobile engines in the design of this intake manifold in order to secure a

more uniform distribution of fuel to the different cylinders.

The spark was kept at 45 degrees early except when the cards were being taken, several revolutions

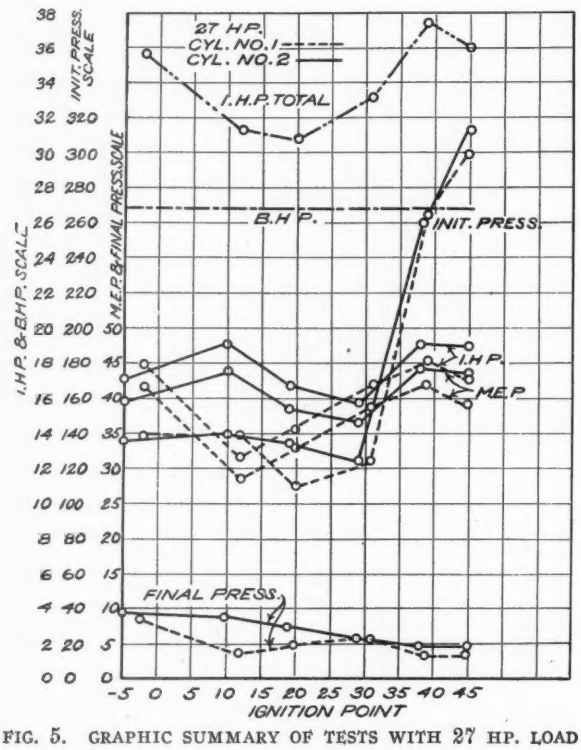
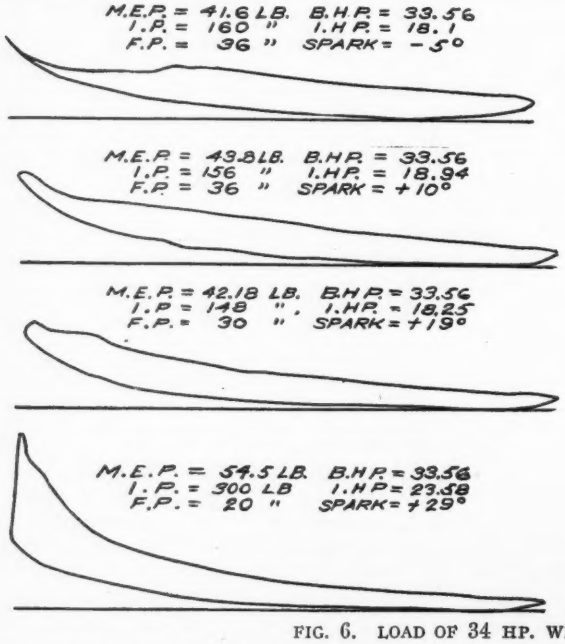


FIG. 5. GRAPHIC SUMMARY OF TESTS WITH 27 HP. LOAD

being allowed to elapse after the spark was changed and before the cards were taken to be sure that normal


M.E.P. = 41.6 LB. B.H.P. = 33.56
I.P. = 160 " I.H.P. = 18.1
F.P. = 36 " SPARK = −5°
M.E.P. = 43.8 LB. B.H.P. = 33.56
I.P. = 156 " I.H.P. = 18.94
F.P. = 36 " SPARK = +10°
M.E.P. = 42.18 LB. B.H.P. = 33.56
I.P. = 148 " I.H.P. = 18.25
F.P. = 30 " SPARK = +19°
M.E.P. = 54.5 LB. B.H.P. = 33.56
I.P. = 300 LB I.H.P. = 23.58
F.P. = 20 " SPARK = +29°

practice. The cards shown are all taken from cylinder No. 2.

Figure 2 shows the cards obtained, while Fig. 3 gives a graphic summary of the results with a brake

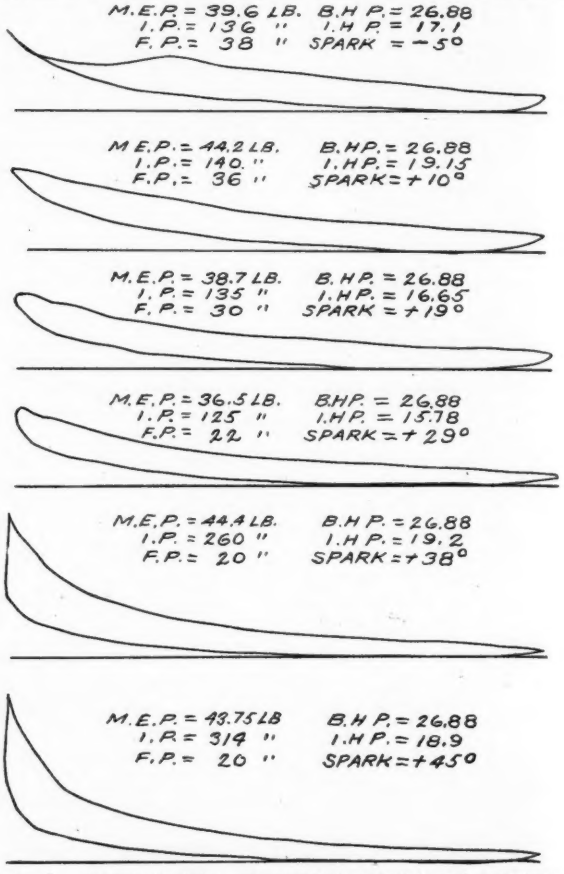

M.E.P. = 39.6 LB. B.H.P. = 26.88
I.P. = 136 " I.H.P. = 17.1
F.P. = 38 " SPARK = −5°
M.E.P. = 44.2 LB. B.H.P. = 26.88
I.P. = 140 " I.H.P. = 19.15
F.P. = 36 " SPARK = +10°
M.E.P. = 38.7 LB. B.H.P. = 26.88
I.P. = 135 " I.H.P. = 16.65
F.P. = 30 " SPARK = +19°
M.E.P. = 36.5 LB. B.H.P. = 26.88
I.P. = 125 " I.H.P. = 15.78
F.P. = 22 " SPARK = +29°
M.E.P. = 44.4 LB. B.H.P. = 26.88
I.P. = 260 " I.H.P. = 19.2
F.P. = 20 " SPARK = +38°
M.E.P. = 43.75 LB B.H.P. = 26.88
I.P. = 314 " I.H.P. = 18.9
F.P. = 20 " SPARK = +45°

FIG. 4. CARDS TAKEN AT VARIOUS POINTS OF IGNITION WITH LOAD OF 27 HP.

horsepower of 20, Figs. 4 and 5 are from the 27-hp. load, Figs. 6 and 7 from the 34-hp. load, and Figs.

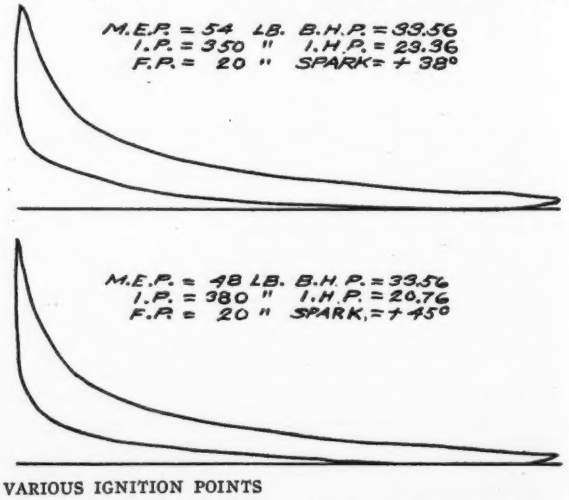


FIG. 6. LOAD OF 34 HP. WITH VARIOUS IGNITION POINTS

cards for that point of ignition were obtained. It is not deemed necessary to show cards of curves for loads lighter than 50 per cent of the rated capacity of the engine as that condition seldom obtains in

8 and 9 from the 43-hp. load. The friction of this engine amounts to about 10 hp.; looking at Figs. 2 and 3 it will be seen that the first load on the engine, 20 hp., could not be carried with a spark later than

20 degrees early, the indicated horsepower for all such points being less than the sum of the brake and friction horsepowers. It would quickly slow down with this late spark and the heavier loads show that a more advanced spark is required to carry them successfully. Attention is called on third and all succeeding curves to the rapidly increasing initial pressure, corresponding but slower increase of mean effective pressure, and the decreasing exhaust pressure as the spark is advanced.

These curves show that a distinct advantage is gained with an early ignition in 2 out of 3 observed quantities taken from the cards, namely the mean

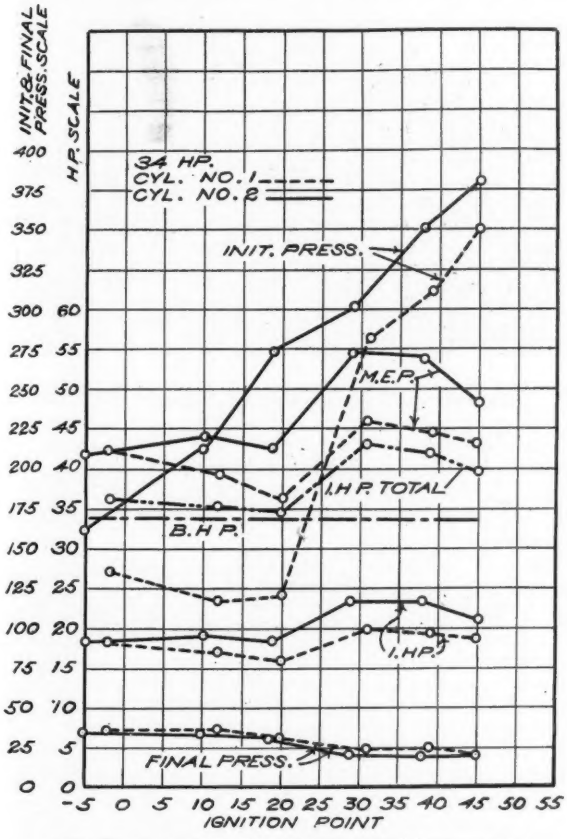


FIG. 7. SUMMARY OF TESTS WITH 34 HP. LOAD

effective pressures and the decreasing exhaust pressures, while a serious disadvantage is encountered in the rapidly rising initial pressures. The mean effective pressure rises as the spark is advanced showing that a greater amount of work is being done with the same amount of gas per revolution, thus decreasing the fuel consumption. The final pressure decreases from 50 to 20 per cent. Now the temperature of this gas depends upon its pressure, consequently the gases leave the cylinder at a much lower exhaust temperature and there is not nearly the tendency to warp the exhaust valves with a low exhaust temperature that there is with a high exhaust temperature, consequently there is much less trouble with leaky exhaust valves.

These 2 distinct advantages are gained at the expense of a serious disadvantage, namely, the rapid increase of the initial pressure. The designer must consider this high initial pressure and make the cylinder head and walls, stud bolts, wrist pin, piston, connecting rod, crank, and main shaft all correspondingly heavy. This is objectionable in every way. Designers and manufacturers, therefore, will be deeply indebted to the investigator who will discover some method of burning this gas economically and avoiding this high initial pressure.

The first indication that the ignition is too early will be a pound in the cylinders at the beginning of

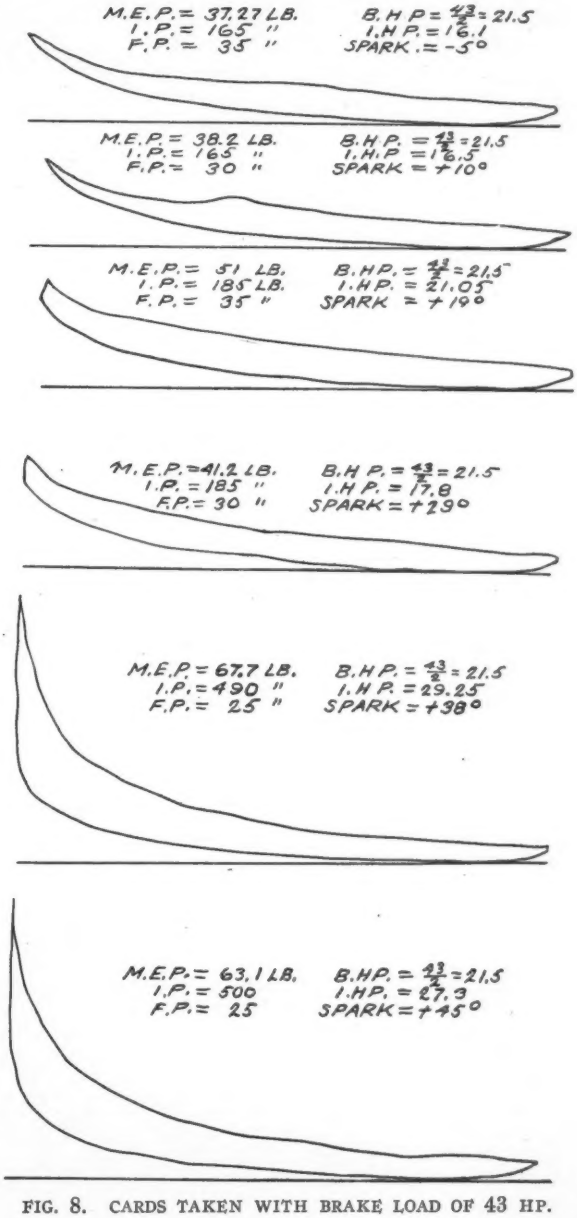


FIG. 8. CARDS TAKEN WITH BRAKE LOAD OF 43 HP.

each expansion stroke. When this pound is heard and all bearings are known to be tight, it may be regarded as a warning not to advance the spark further and to retard it, if it is excessive. A slight pound, however, due to early ignition is not objectionable. If this warning be disregarded and the spark still further advanced, a condition similar to preignition will occur, the card will approach the preignition card in shape, the mean effective pressure will become lower, and the engine will slow down, the pound in

the cylinder increasing to a certain point and then dying out if the charge is ignited early enough to show preignition. These symptoms of too early ignition may be recognized without the use of an indicator.

A late spark will quickly make itself known by backfiring, preigniting, or the engine refusing to carry its load. The mixture ignited late in the stroke burns so slowly that it is still burning at the beginning of the suction stroke and ignites the incoming charge exploding it through the intake pipe with a loud, sharp, metallic "bing."

A preignition is not so easily recognized. It is caused by a lingering flame or incandescent point in-

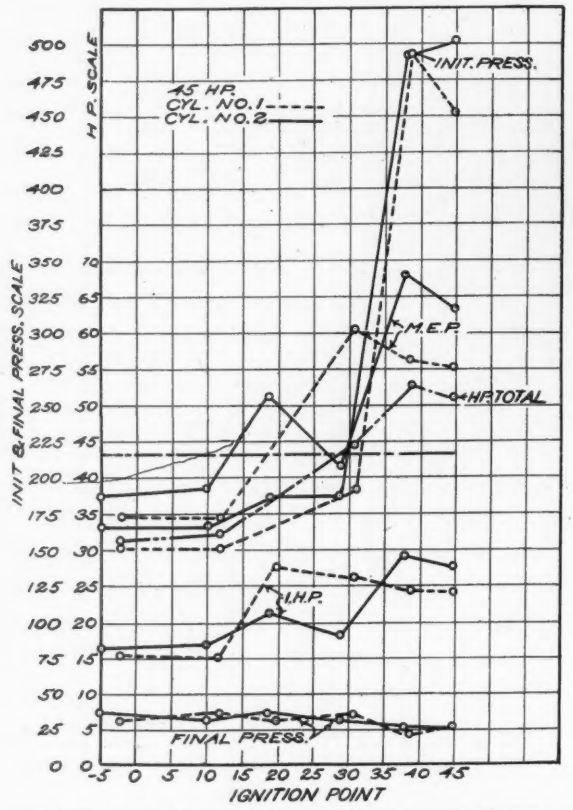


FIG. 9. SUMMARY OF TESTS WITH LOAD OF 43 HP.

side the cylinder igniting the charge at the beginning of the compression stroke. Frequent preignitions will cause the engine to slow down but as back firing usually occurs intermittently with preignition, the latter is not so easily noticed.

In conclusion it might be said that good practice consists in igniting the mixture as early in the stroke as is possible without too heavy pounding in the cylinder. A rough method of finding the proper point of ignition is to advance the spark to a point where a slight pound is heard in the cylinders, for this slight pound will do no harm and the operator may be sure that the gas is being burned economically.

PORTLAND CEMENT, dried at 212 deg. F., should have a specific gravity of 3.1, and begin to set in not less than 30 min. and develop hard in not more than 10 hr.; natural cement, dried at the same temperature has a specific gravity of 2.8 and the time for setting, 10 min. for initial and 3 hr. final.

BOILER EXPLOSION

BY A. REDER

ON the morning of Oct. 11, at 8:50, as the Witham & Bowen Planing Mill at Union City, Ind., was in operation, the boiler exploded, wrecking the building completely, as indicated in the illustration herewith. The boiler was of iron, of the return tubular type, 16 ft. by 52 in., having 48 3.5-in. tubes; it was made of 5/16-in. plate, heads ½-in., having 5 ¾-in. round braces. The boiler was made of 2 sheets with double riveted lap joints having

FIG. 1. WRECK OF THE PLANING MILL AT UNION CITY, IND.

11/16-in. rivets varying in pitch from 2.5 to 3.5 in., was equipped with a dome and mud drum and had been in use 28 yr. all of the time in charge of the same attendant.

At the fractured edges the iron gave evidence of a nearly perfect crystallization and nearly all the submerged parts of the plates were wasted away to the thickness of about ¼ in. on the flange. The boiler gave way as indicated on Fig. 2, the sections marked

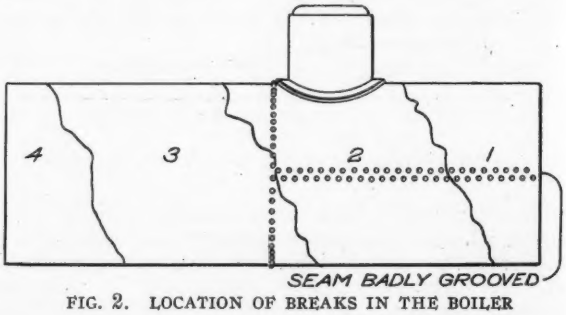


FIG. 2. LOCATION OF BREAKS IN THE BOILER

2 and 3 being opened out nearly flat. All the tubes were pulled clear of the heads and blown to a great distance, 4 being deposited on a shed roof at a distance of 150 ft. Brick from the boiler setting was thrown through the side of a steel stack 175 ft. away. Statement is made that the safety valve which was in good order was set to blow at 60 lb., but this valve has not been found as yet. The boiler was free from scale and evidently well supplied with water at the time of the explosion. Apparently corrosion of plate is responsible for the occurrence. Fortunately no one was seriously injured, as the boiler attendant had just shut off the injector and stepped outside the boiler room.

SHOP KINKS

EMERGENCY DEVICES, HANDY TOOLS, UNIQUE METHODS

FOR temporary support of one end of a short length of 1¼-in. shafting when the hanger broke, a makeshift was used, constructed of pipe and pipe fittings as indicated in the sketch, Fig. 1. A 1½-in. floor flange was found and into this a piece of 1½-in. pipe was screwed with a tee on the end. Before putting the device up, the end of the upright pipe was stuffed with a wad of paper; a piece of 1¼-in. shaft held in the flame of a torch until it was black and used as a mandrel to Babbitt the tee for the shafting. The shaft was knocked out and the hole reamed, a hole drilled

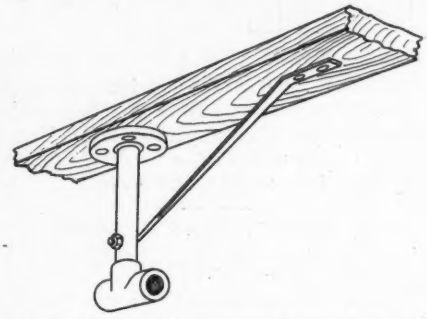


FIG. 1. A TEMPORARY SHAFT HANGER

through the vertical piece for the stay and the whole thing put in place where it ran for a week until a new hanger was secured. Two holes were, of course, drilled through the upper part of the tee for oil holes.

A Troublesome Ring Oiler

ON the armature shaft of a Manchester type dynamo in an English station trouble was experienced with a ring-oiled bearing having only 1 ring. As told in The Engineer-in-Charge, by O. G. A. Pettersson, a long box with 2 tubes was provided for oiling each end of the bearing but this was found inconvenient. Unless the siphon box was used the ends of the bearings

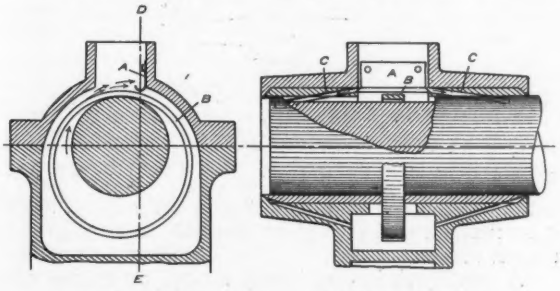


FIG. 2. REMEDY FOR A HEATING BEARING

were found to get hot, so a trough of sheet metal was placed above the ring oiler, as shown in Fig. 2, so that it caught the oil thrown off the ring by centrifugal force. From this trough the oil was sent towards the ends of the bearings, through holes drilled in the cap and top of brass, as shown in the figure. The direction of flow of the oil was as indicated by the arrows.

Steel Belts

IN regard to the subject of steel belts, a form has recently come to our attention, manufactured by the Eloesser Steel Belt Co., of Berlin. The method used for joining the ends of the belt, which is illustrated in Fig. 3, is the characteristic feature. This belt is particularly well suited for large power drives, a speed of 300 ft. a second or 18,000 ft. a minute being allowable. It is stated that the slip does not exceed 0.1 of 1 per cent and the power transmitted is nearly proportional to the diameters of the pulleys. An advantage of the steel belt is that no stretching occurs, even after long use.

Speaking of experience with these belts an English user states that he has had 12 months' experience with several drives varying from 3 to 80 hp., and finds them very well suited for the purpose. In one case a 14-in

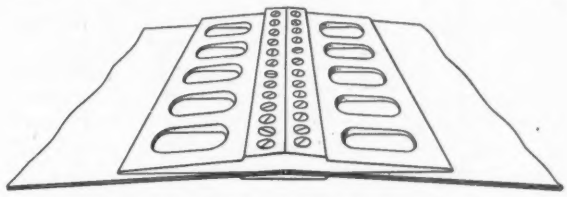


FIG. 3. CLAMP FOR THE ENDS OF STEEL BELT

camel's hair was replaced by a steel belt 4 in. wide and after 9 months' use it was reported as giving no trouble.

Two Useful Tools

IN the Engineer-in-Charge, C. H. Copeland shows 2 tools which he has used about his boiler plant with great satisfaction. The first is for cleaning up the faces of Babcock & Wilcox boiler headers. Two circular plates were flattened out and turned or filed so as to grip a piece of emery cloth between them. The smaller of these plates is a loose fit in the handholes of the headers, while the larger is sufficiently large to cover the finished surface against which the caps rest.

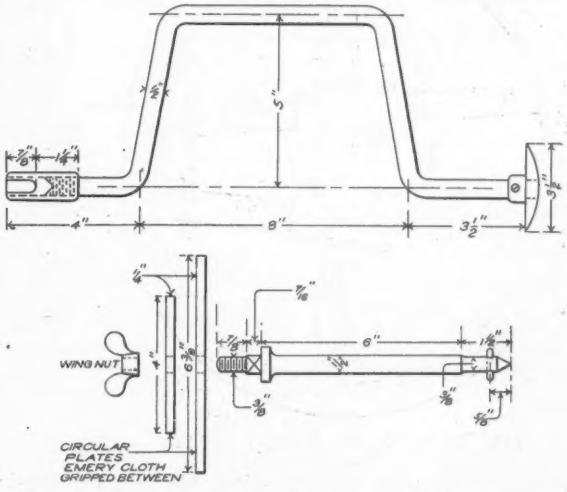


FIG. 4. DETAILS OF THE BRACE AND EMERY PLATES FOR CLEANING BOILER CAP SEATS

The spindle, plates and nuts and the method of putting on the emery cloth are obvious from the illustration, Fig. 4.

The end of the spindle was not made square, as is usually the case with braces, but is made with taper

and a pin driven through it. The end of the brace is made by tapping out a piece of ⅜-in. steam pipe with ½-in. screw thread and screwing onto the brace, and a center in the end of the brace takes the end of the spindle. In the ⅜-in. pipe 2 slots are cut opposite each other to engage the spindle pin, which does not bottom in the slot, so that the emery disk is free to adjust itself to the header surface even if the brace is not held quite square. A sheet of emery cloth held on a flat plate is used to clean the faces of the caps.

For refacing valve seats a cutter is made of tool steel with guide bushes and spindle of mild steel, the

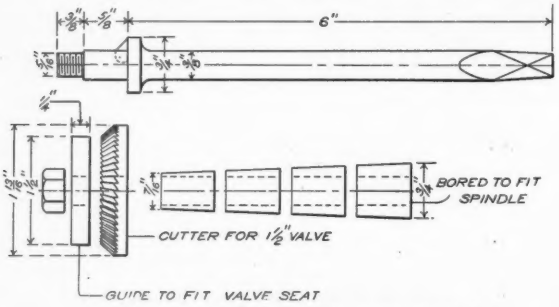


FIG. 5. REFACING TOOL FOR VALVE SEATS

ends of the spindle being squared to go into a common bit brace. With cutters of proper size, this device will reface valves from ½ in. up to 2 in. The taper bushes are bored out to fit over the spindle of the tool, as shown in Fig. 5, and are used to fit into the gland of the valve to center the spindle when using the tool. The outside diameter of the cutter for a 1½-in. valve is 1 13/16 in.; for a 2-in. valve, 2¼ in.; for 1¼-in. valve, 1 9/16 in.; for 1-in. valve, 1 3/16 in.; for ¾-in. valve, 15/16 in., and for ½-in. valve 25/32 in.

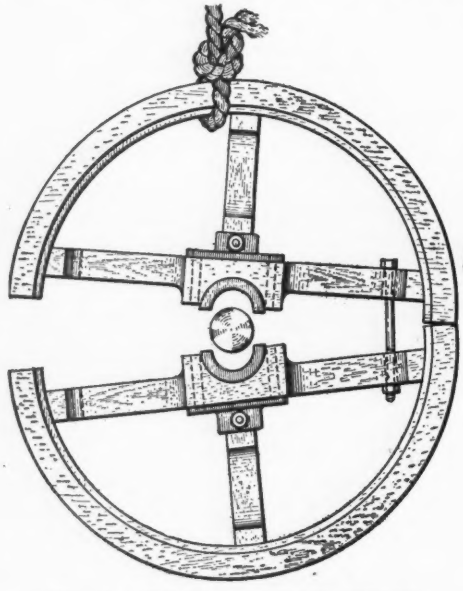


FIG. 6. HANGING A SPLIT PULLEY

Hanging a Big Split Pulley

FOR hanging split pulleys which are large enough to make the job an awkward one, a convenient dodge is to take all the bolts out, and then put in a size smaller bolts at one of the rim joints. These bolts are left partly screwed up so that after the 2 halves of the pulley are hoisted in place by a swing rope, the other side of the rim may be opened and the pulley hub slipped over the shaft. Bolts at hub and rim may then be put in of the proper size and tightened up.

Foundation Bolts

FOR foundation bolts to be used in an emergency or permanently the illustrations show several forms. The first is a piece of angle iron with an ordinary square head bolt, the hole for the bolt being drilled

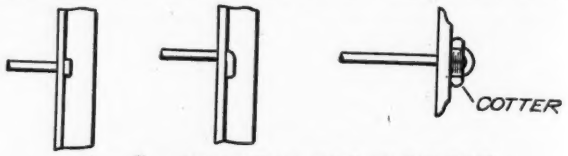


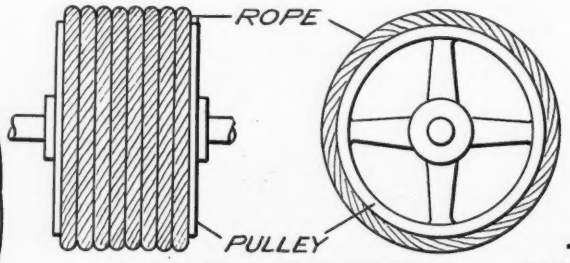
FIG. 7. FOUNDATION BOLT FASTENINGS

close to the angle so that the head cannot turn. The second is a bolt with the end doubled over and is more of an emergency job than anything else. The third is a bolt with a cotter to hold the washer, the end of the bolt being turned up against the cotter.

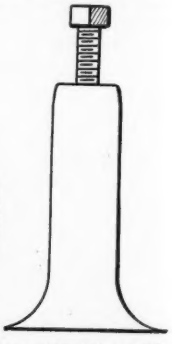
A SMALL SCREW JACK

By John Trewak

SOME time ago I was doing a job where a small jack would have been very handy; not having one I had to use a wedge. So in order to be prepared for the feature I looked around for material out of which to make one. I found a piece of 1½-in. extra heavy pressure pipe. I went to the blacksmith shop and expanded one end into a bell shape for the bottom and cut off the length I wanted. The hole was too large for my set screw so I got the top end hot and with the aid of the top and bottom wedge and a helper I shaped it so that I could straighten the hole to be tapped for the set screw.



PULLEY MADE LARGER WITH ROPE



HANDY SCREW JACK

A small jack is very handy around an engine when there is any repairing to do. It does not take much skill to make one and the material will be found in the scrap in most engine rooms.

INCREASING DIAMETER OF PULLEYS

TO increase the diameter of a pulley, take a 4-strand Manila rope and make one end fast with a hook-shaped ¼-in. bolt. Wrap the rope tightly around the pulley, making the other end fast in the same manner as the first one.

THE MAN WHO cultivates the belief that the world lives by humbug soon learns to say "and so will I."

HEATING AND VENTILATING EQUIPMENT OF A MODERN BANK BUILDING

ONE of the most perfectly equipped structures of its kind is the new building of the Boston Safe Deposit and Trust Company on Franklin Street between Devonshire and Arch. Not only as regards banking and business equipment but also in the matter of power plant, heating and ventilating installation and other mechanical features it exemplifies the most modern departures. The system of heating and ventilation adopted in this building is a combination of Webster Modulation direct heating and an indirect fan heating system. Furthermore, wherever possible the Modulation System has been adapted to a direct-indirect system. The entire heating and ventilating equipment was designed and installed by Buerkel & Co., of Boston. The Modulation direct heating system and the air washer used in connection with the fan system are manufactured by Warren Webster & Co., Camden, N. J. Fans, motors, and indirect heaters are from the works of the B. F. Sturtevant Co., Hyde Park, Mass.

The bank building comprises a subbasement, basement, main banking floor, mezzanine floor, and 8 floors of rented offices. All the offices and corridors are heated by the Modulation System, while the banking department as well as the basements are on the indirect system. The power plant including the heating and ventilating apparatus, a laboratory and storage rooms occupy the subbasement. In the basement is located the safe deposit department including vaults, coupon room, etc.

The main banking rooms and offices occupy the entire ground floor excepting the part taken up by the main corridor which is at the back of the building and runs entirely through from Devonshire to Arch Streets with an entrance on each street. Surrounding the main banking room is a mezzanine floor, upon which are located additional offices for the clerical force of the bank.

Fresh air for the main indirect system is taken in over the main doorway on the Devonshire Street side and is led through a brick downtake to the main supply duct, located under the subbasement floor. This duct which is of concrete leads to an uptake through a floor grating into the main ventilating duct leading to the Webster air washer. From the washer the air goes to the main fan and is then distributed throughout the system. A primary heater consisting of a Sturtevant tempering coil of 2868 linear feet of 1-in. pipe is located at the entrance to the air washer. Between the washer and the main fan is the main heater which is made up of 4780 linear feet of 1-in. pipe set in 2 banks.

System of Air Washing

THE Webster air washer consists of a housing of 18-ounce copper braced with 1½ by 1½-in. angles containing a spray head and its attendent piping and the eliminator which is made up of 2 rows of V-shaped baffles. Its dimensions are 10 ft. 1½ in. high by 11 ft. 2 in. wide. Below the washer is a concrete tank which acts as a receiver for the spray water and a source of supply for the centrifugal circulating pump. The latter is a 2½-in. unit, belt driven by a 7½-hp. motor and runs at 1500 r.p.m.

When in operation the entire cross section of the washer is filled with 2 parallel sheets of finely divided spray which is discharged from the spray head at the top of the washer. The ventilating air is drawn through this double curtain of water particles by the fan and so thorough is the scrubbing action of the combination rain and spray effect peculiar to this air washer that 98 per cent of all solid matter is removed from the air during its passage. The function of the eliminator is to remove whatever mechanically entrained water the air may contain and then the latter passes through the reheater where it is warmed to the temperature desired for distribution through the bank. The capacity of the washer is 40,000 cu. ft. a minute.

Fresh Air Supply

MAIN ventilation is secured by a Sturtevant steel plate fan, 108 in. in diameter and 54 in. in width. It is direct driven by a 25-hp. Sturtevant motor which operates on 220 volts and is specified as capable of handling 4520 cu. ft. of air at full speed. Two outlets are provided from the fan and galvanized iron ducts lead from them along the subbasement ceiling to vertical risers at opposite ends of the building from which branches are taken to the different parts of the basement vaults, laboratory, mezzanine floor, and the main banking rooms. These ducts all end in register boxes of cast iron, the greater part of which are placed in the side walls and are located in such a manner as to avoid any possibility of drafts upon the occupants.

A Sturtevant steel plate exhaust fan 84 in. in diameter and capable of handling 32,000 cu. ft. of air a minute is located upon the roof of the building for the purpose of abstracting the vitiated air from the banking floors through a series of galvanized iron ducts converging to a vertical brick riser. This fan is driven by a 13-hp. Sturtevant motor, which is started and stopped from the engine room by means of remote control electrical starting device.

A secondary indirect system has been installed for the ventilation of the boiler, engine and pump rooms. A fresh air downtake similar to that of the main fan system supplies a 54-in. Sturtevant steel plate fan which has a capacity of 12,700 cu. ft. a minute, which is direct driven by a 6-hp. motor running at 315 r.p.m.

Besides the indirect systems mentioned there is another exhaust fan system for the ventilation of the toilets, closets, and lockers. These are in general vented through the fixtures to ducts leading to a vertical riser. The fan for this auxiliary system is located on the roof. It is a 36-in. steel plate fan capable of exhausting 5220 cu. ft. of air a minute at 477 revolutions and is driven by a direct connected 2½-hp. motor.

Indirect System

OPERATION of the indirect system and the air washer has been particularly successful in this installation and the impression upon entering the bank from the street is always of agreeable freshness and proper temperature. It has been a matter of considerable interest to the bank officials personally to determine how great an amount of cooling could be attained in hot weather by means of the air washer and the results are reported to have been most satis-

factory to all concerned. It has been possible to maintain the temperature in the bank 10 deg. lower than obtained in the street during the past summer. In order to permit the system to work to best possible advantage all windows are kept closed and revolving doors exclude most of the air that would otherwise obtain admission from the street.

The engineer of the building who has direct charge of the heating system said recently that the Webster washer required practically no attention at all. Beyond the mere starting and stopping of the circulating pump the only operation that had to be performed was the flushing out of the tank once a week in order to remove the deposit of mud which collects in that time. About 1 in. of mud is the usual amount and this is gotten rid of very easily by means of the flush-out valve provided. No trouble whatsoever has been experienced from clogging of the spray heads due to the generous proportions of the openings provided in this washer.

Modulation Heating System

HEATING system for the parts of the building not connected with the indirect system consisting of the rented offices and corridors as well as the main floor corridors consists of the Webster Modulation heating system manufactured by and installed under the direction of Warren Webster & Co., of Camden, N. J. The majority of the radiators were arranged for direct-indirect heating. It was possible to use this system in practically all of the offices because of the large amount of wall space relative to the area in this building. The corridors, being to a large extent within the building, are on the ordinary direct system.

In the direct-indirect system the radiator is set beneath the window and a narrow slot 2 by 20 in. pierces the wall about on a line with the top of the radiator. This slot connects with a vertical duct underneath the plaster on the inside of the building wall. From the bottom of the latter nearly at the floor line a short duct carries the air to the base of the radiator. At this point deflecting dampers cause the incoming air to flow upward over the radiator coils. In the horizontal duct there is provided a shut-off damper which is operated by a small knob just above the radiator. The deflecting dampers may be set in any of several positions according to the results desired and may also be closed entirely, therefore, if either damper is shut the air cannot pass through the duct and the radiator acts as a direct heating unit.

Each radiator is equipped with a standard Webster Modulation valve on the inlet and a Webster Water Seal motor on the discharge end. The function of the motor is automatically to discharge water and air to the returns while preventing the passage of steam from the radiator. The Modulation valve is hand operated and governs the amount of steam admitted to the radiator and consequently the amount of steam radiated. By the use of this system the occupant of each room is enabled to modulate the temperature as he pleases by simply adjusting the valve.

As the return end of the radiator is sealed there is no possibility of steam backing up from the returns and accordingly a positive flow from the risers into the radiator is always obtained however slight the opening of the Modulation valve may be and a very slight pressure only is needed on the entire system. The engineer of the bank building states that it was never necessary to carry more than ½ lb. pressure for heating at any time during the winter and that for a large part of the cold weather you could not find the pressure on the gage. No trouble of any kind was experienced with the system and the temperature regulation was found to be flexible and exact at all times.

Three Heine 153-hp. boilers generate steam for all purposes at 120 lb. pressure. A main heating header of 10-in. pipe is supplied with steam from the main engine exhausts and various pump and other auxiliary exhausts. This header branches into 2 main supply pipes one of 8 in. diameter for the low pressure tempering coil and reheater of the indirect system and the other a 10-in. pipe supplying the riser for the Modulation system. Both these mains are cross connected to the high pressure steam header through a reducing valve in order that either or both systems may be supplied with live steam direct from the boilers if at any time necessary.

The main exhaust header terminates in the feed-water heater at one end and at the other connects with a 10-in. free exhaust pipe through a back-pressure valve. The exhaust is carried to the roof and a 10-in. Swartwout exhaust head surmounts the free exhaust pipe. A 4-in. vapor line from the boiler blowoff tank is likewise carried to the roof beside the free exhaust pipe and is also provided with a Swartwout head.

There are 21 risers varying in size from 2 to 3 in. supplying 320 cast-iron radiators of various sizes containing 11,960 sq. ft. of surface. The returns and the drips from the risers are collected in a 4-in. main return line in the boiler room which carries the condensed steam to the automatic return tank situated above the 2 Warren steam driven boiler-feed pumps. The drips and return line from the indirect heaters are also carried to the automatic return tank which is the source of supply of the feed pump. All risers and returns are provided with expansion joints at a point just above the third floor and are anchored at 2 points to the steel framing of the building. All steam lines of the system are dripped through traps to the return tank. Concealed piping was in all cases subjected to a 24-hr. test for tightness under 50 lb. hydraulic pressure before being closed in, and all radiators were tested to 100 lb. pressure before being installed.

The heating and ventilation system has proven itself perfectly satisfactory to all concerned and while in many respects it is novel, experience has proven the wisdom of the steps taken. Not only in regard to the heating system but in the equipment throughout it might well serve as a model for banking buildings and structures of a similar nature in the future. The architects of this building were Shepley, Rutan and Coolidge, of Boston.

MODULATION SYSTEM OF STEAM HEATING

AS between steam and water for heating small buildings each has had its advantages. The difficulty with steam has been to regulate the temperature in the rooms accurately, a radiator having full head of steam and an open window not being an economical performance. In the hot water systems, on the other hand, the temperature can be modulated carefully by the heating of the water, but cannot be changed quickly.

The new system provides for accurate regulation of temperatures with the use of steam, thus giving the advantages of both systems. The result is accomplished by an adjustable valve on the intake end

of the radiator and an automatic air and water valve on the discharge end. This latter allows the discharge of water back to the boiler but prevents steam from escaping, while the modulation valve at the inlet end, which is operated by hand, permits of the radiator being wholly or partly filled with steam.

This method allows the use of a low steam pressure, from ½ lb. to 1 lb. being ample, even in very cold weather. Also positive circulation is obtained, since steam cannot escape to the returns until it has been condensed to water in the radiators. The system has the added advantage that while the general operation is under the control of the engineer in charge, the temperature of any room may be varied at the pleasure of the occupant. The system is not intended to replace the vacuum system in large buildings, but is especially adapted for heating buildings of medium and small size.

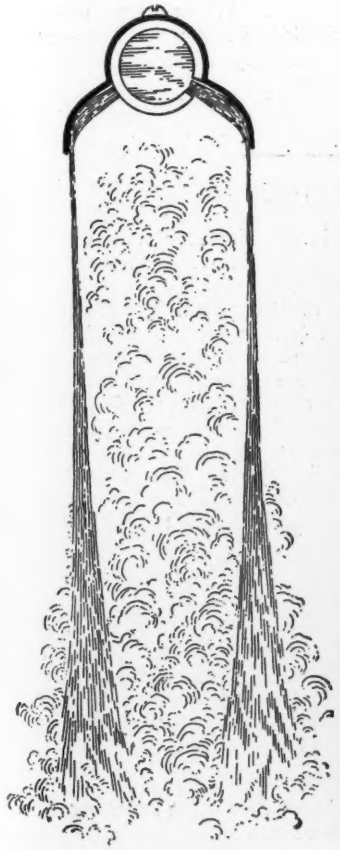


FIG. 3. OPERATION OF SPRAY DEVICE

REGULATING AIR MOISTURE

MODERN study of human comfort has revealed the fact that whether we are "hot" or "cold" depends quite as much on the amount of moisture in the air as it does on the actual temperature. In order to be fully comfortable we must have our humidity right as well as the heat. In providing for ventilating systems it becomes necessary, therefore, according to best modern practice, to have an air washer both for the purpose of removing dirt and impurities from the air as drawn from outdoors in the city and also for the purpose of regulating the moisture which the air carries with it.

To accomplish this Warren Webster & Co., of Camden, N. J., has devised the Webster air washer, which has a novel spray construction for accomplishing the desired end. The perforated brass pipe and copper hood extend across the ceiling of the spray chamber. That is the entire device. The smallest opening of the brass pipe is 7-32 in. in diameter and is, therefore, not subject to clogging.

Spray is thrown out in 2 directions from perforations in this pipe, and striking against the sides of the copper hood is directed downward in the form of a rain or mist through which the air is thrown by a fan. So thoroughly is the air washed that a guarantee is given with the system to remove 98 per cent of all solid matter and soluble gases from the air, and by a series of baffle plates placed behind the spray all extra air is removed from the water and it is left "dry."

This means that there is no moisture in the air other than what it will naturally carry at the temperature at which it leaves the apparatus. It has been shown in practice that the Webster washer when using the sprayed water over and over again will cool entering air from

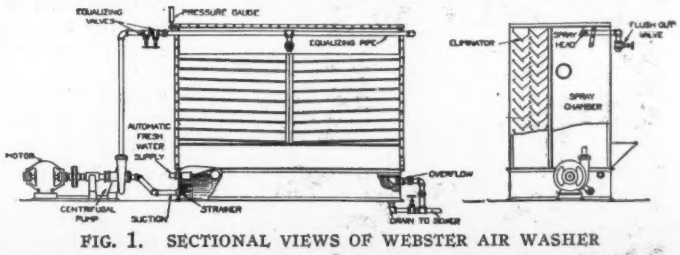


FIG. 1. SECTIONAL VIEWS OF WEBSTER AIR WASHER

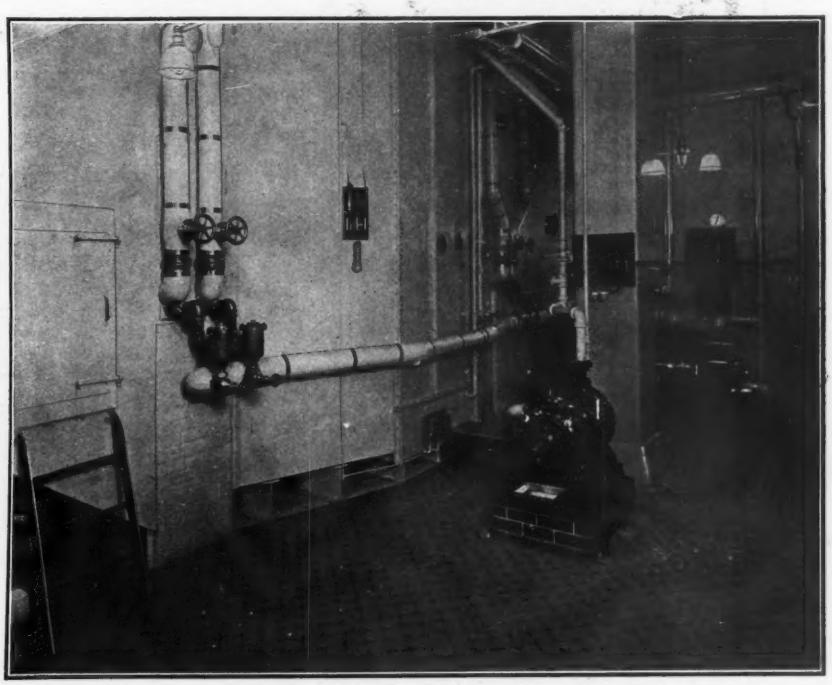


FIG. 4. AIR WASHER INSTALLATION IN THE BALTIMORE SAFE DEPOSIT & TRUST CO. BUILDING

4 to 13 deg. in summer and when running water is used from 5 to 18 deg. The drying of the air by the baffle system is so perfect that the control of the moisture is practically automatic; that is, the amount of spray is regulated to give the washing and the temperature required

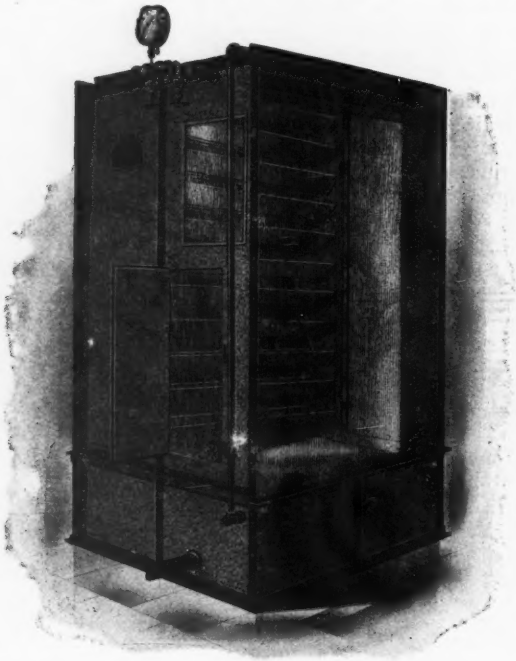


FIG. 2. WEBSTER AIR WASHER AND HUMIDIFIER COMPLETE

for the air and the baffling automatically dries the air, so that it carries its normal amount of moisture.

HEATING KILN WITH EXHAUST STEAM

By A. D. White

I WOULD like to answer B. C. in the September issue regarding heating by exhaust steam. There is one thing that is not quite clear to me, he says his kilns are 30 by 90 in., if this is the size they must be very narrow. But I should rather think they were 30 ft. long by 90 in. wide. If so I think I can help him as I have had considerable experience in this line.

He has an 8 in. exhaust pipe from the engine. At some convenient place near the engine in the exhaust place a 6 by 6 by 8 in. long sweep tee, from one end run a 6 in. pipe up through the floor to heater if one is used, if not near the ceiling place a good back pressure valve and continue on through roof. He might use an exhaust head but that is not necessary.

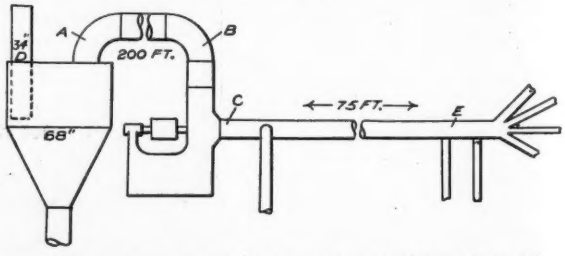
On the other end of tee use a nipple of such a length as is needed, then a good 6-in. gate valve, another close nipple, then a 6 by 6 by 2 in. tee, then run from there as nearly direct as can be and with as few turns as possible to the kilns. If the line has to rise put a ¼ in. drip in lower ell. If there are 3 90 in. by 30 ft. kilns, use 3½-in. pipe for feeders for each kiln, and 1¼-in. pipe for the coil or heating pipes. I would use 3 lines of headers of such a length as will just about fill the width of the kiln. I use about a 4-ft. riser and connect into the horizontal pipes with a right and left ell, risers are generally on the coldest side of kiln as steam is hottest on the start. Give the horizontal pipes a good slant to the outlet end and, in the headers at outlet, use a 1½ or 2-in. outlet for draining with a good globe valve to regulate the drip. Now return to the engine room. At some convenient place on the live steam pipe cut in and take off a 2-in. pipe and run down to the 6 by 6 by 2-in. tee, but before connecting first place a good globe valve at about 5 ft. from floor, then beyond this a good reducing valve, then connect into the tee with a union, and set valve at about 5 lb.

Cover all 6 and 2-in. pipes with good asbestos covering, set your back pressure valve at about 2 lb. and you are ready to heat the kilns. When the engine is running, the 2-in. live steam valve must be closed and the 6-in. valve in the exhaust open. When you shut down for night close the 6-in. valve and open the 2-in. valve and the reducing valve will give you plenty of steam in the kilns. When using exhaust steam open the drip in the kiln wide, when live steam, throttle down until it is nearly closed as this will effect a saving in the steam.

I think that 7 cords of edgings ought to be a plenty to do the heating if this is all he has to heat.

CYCLONE DEPARTMENT

MY Cyclone is 68 in. in diameter with an inlet 14 by 24 in., an outlet 34 in. diameter, and a fan, which is 60-in., having a wheel 37 in. in diameter running at 1546 r.p.m. For the points shown in the figure the pressures are as follows: Vacuum at C, 2 in., vacuum at E, 1¾ in., back pressure at A, 1¾ in., back pressure at B, over 7 in. The arrangement is as shown on the figure, the fan having a suction pipe 75 ft. long with various inlets, the combined openings being 412 sq. in. The distance from the fan to the Cyclone is 200 ft. The diameter of the pipe at the inlet to the fan is 24 in. The vacuum at the machines from the switchboard to the shavings



ARRANGEMENT OF CYCLONE AND MEASUREMENT OF PRESSURES

as drawn is in one instance 1¼ in. and in another 1¾ in. The fan is belt driven from the overhead shaft. F. F. W.

In regard to your Cyclone system, we find as follows: Your Cyclone is 68 in. in diameter and our figures show that it ought to be 108 in. The outlet is 34 in. diameter and should be 54 in. If these changes were made the fan could be run at 600 r.p.m. instead of 1546, the horsepower would be 10 instead of 30, and the saving in power would pay for the cost in 4 months.

The 2 elbows which you have in your system between the blower and the Cyclone should be 8-piece elbows or made with a long radius so as to give easy flow to the air.

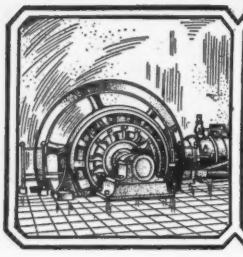
THEORETICAL RATE OF STEAM CONSUMPTION

IN studying engine tests it is interesting always to know how near an engine is coming to the possibility of a perfect engine. The table herewith shows the theoretical water consumption per hour for various conditions of pressure, vacuum and superheat. If for instance an engine running at 125 lb. gage pressure with 26 in. vacuum and no superheat gave a steam consumption of 15 lb. per hour per horsepower, it will be seen by looking at the table, remembering that 125 lb. gage is the same as 140 lb. absolute, that the theoretical consumption is 12.3 lb. It is also interesting to note that by superheating to 100 deg., this theoretical consumption can be reduced to 11.55 lb. It is seen therefore that the engine is doing 82 per cent of the theoretical possibility, and also by comparing the 2 values, the theoretical saving by 100 deg. superheat is 5.65 per cent. For the table we are indebted to the General Electric Review.

THEORETICAL RATE OF WATER CONSUMPTION

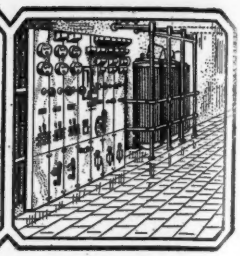
SUPERHEAT F°		200°	150°	100°	50°	0°
Lbs. Abs. Pres.	In Vac.	Theoretical W.R.				
215	29	8.45	8.7	8.95	7.2	9.45
215	28	9.	9.25	9.5	9.75	10.
215	27	9.5	9.75	10.05	10.3	10.55
215	26	9.9	10.2	10.50	10.8	11.11
215	20	11.65	12.07	12.50	12.87	13.25
215	10	13.65	14.15	14.65	15.15	15.65
215	0	15.25	15.8	16.4	16.9	17.4
215	2 lb. bk. pres.	15.05	16.07	17.1	17.6	18.2
200	29	8.55	8.8	9.05	9.32	9.6
200	28	9.1	9.4	9.7	9.95	10.2
200	27	9.6	9.9	10.2	10.45	10.75
200	26	10.	10.32	10.65	10.97	11.3
200	20	11.75	12.4	12.8	13.2	13.6
200	10	14.	14.5	15.05	15.57	16.
200	0	15.6	16.2	16.9	17.4	17.9
200	2 lb. bk. pres.	16.3	16.9	17.5	18.	18.7
175	29	8.75	9.02	9.3	9.55	9.8
175	28	9.35	9.62	9.9	10.18	10.45
175	27	9.85	10.15	10.45	10.75	11.05
175	26	10.3	10.65	11.	11.3	11.6
175	20	12.4	12.82	13.25	13.65	14.05
175	10	14.65	15.77	15.70	16.25	16.8
175	0	16.4	17.35	18.3	18.6	18.9
175	2 lb. bk. pres.	17.1	17.75	18.4	19.1	12.8
165	29	8.85	9.12	9.4	9.63	9.86
165	28	9.45	9.72	10.	10.3	10.6
165	27	10.	10.32	10.65	11.	11.3
165	26	10.5	10.85	11.2	11.55	11.9
165	20	12.6	13.05	13.5	13.9	14.3
165	10	14.9	15.05	16.1	16.57	17.05
165	0	16.85	17.52	18.2	18.75	19.3
165	2 lb. bk. pres.	17.6	17.3	19.	.....	20.3
140	29	9.12	9.37	9.65	9.9	10.2
140	28	9.75	10.05	10.35	10.65	10.95
140	27	10.3	10.62	10.95	11.28	11.62
140	26	10.85	11.20	11.55	11.95	12.3
140	20	13.1	13.6	14.1	14.6	15.1
140	10	15.8	16.4	17.	17.6	18.2
140	0	17.9	18.6	19.3	20.	20.65
140	2 lb. bk. pres.	18.6	18.95	20.3	21.	21.8
125	29	9.35	.....	9.88	.....	10.4
125	28	10.03	.....	10.6	.....	11.2
125	27	10.70	.....	11.3	11.6	11.9
125	26	11.23	.....	11.9	.....	12.55
125	20	13.65	.....	14.6	.....	15.50
125	10	16.50	.....	17.7	.....	18.98
125	0	18.90	.....	20.4	.....	21.80
125	2 lb. bk. pres.	19.85	.....	21.6	.....	23.1
100	29	9.77	.....	10.25	.....	10.89
100	28	10.50	.....	11.16	.....	11.72
100	27	11.2	.....	11.9	.....	12.50
100	26	11.83	.....	12.65	.....	13.23
100	20	14.70	.....	15.80	.....	16.65
100	10	18.	.....	19.45	.....	20.7
100	0	20.9	.....	22.28	.....	24.25
100	2 lb. bk. pres.	22.15	.....	24.25	.....	25.82
Atmos. (14.7 lb.)	29	15.4	.....	16.65	.....	17.7
Atmos. (14.7 lb.)	28	17.65	.....	19.1	.....	20.4
Atmos. (14.7 lb.)	27	20.	.....	21.8	.....	23.3
Atmos. (14.7 lb.)	26	22.40	.....	24.5	.....	25.4
10 in. Vac. (10 lb.)	29	17.25	.....	18.8	.....	20.2
	28	20.20	.....	22.1	.....	24.2
	27	23.50	.....	25.8	.....	28.6
	26	26.95	.....	30.	.....	33.

IT IS NOT ALWAYS within the power of the operating engineer to specify the size of boiler plates, rivets, etc., which shall go in the boiler, but he controls the steam pressure carried and should be sure he is on the safe side.



Electrical Machinery

For Generating, Transmitting and Using Current



ELECTRICAL COMPUTATIONS

EVERYDAY FIGURING ON ENGINE ROOM PROBLEMS

WHILE the usual manipulations of electrical machines is a matter of common knowledge in the engine room, there is some figuring required which is found bothersome and some relations between values that are not entirely clear in the minds of all engineers; which is the reason for the present explanation of examples.

Practically all examples start with current and voltage and between these there is the same relation as between volume flowing per minute and pressure in a steam or water pipe.

Volume of steam per minute, measured in cubic feet times pressure per square foot gives power delivered; so current times voltage gives power delivered. But in the electrical problem our units, the ampere the volt and the watt have been made for convenience so that 1 ampere × 1 volt = 1 watt, whereas 1 cubic foot of steam per minute × 1 pound per square foot = 1/33,000 of a horsepower. To get the power in an electric circuit, therefore, multiply the amperes by the volts and it gives the watts; and to reduce this to horsepower, divide by 746.

Load on a Dynamo

FOR instance on a switchboard the readings are, voltage 118, current from one dynamo 320 amperes, from the other 576 amperes, the first being a 50 kilowatt capacity and the second a 75 kilowatt. What percentage of its capacity is each machine carrying?

The first is doing 118×320=37,760 watts; or as a kilowatt is 1000 watts, it is doing 37,760÷1000=37.76 kilowatts. And this is 37.76÷50=0.755 or 75.5 per cent of its rating.

For the second dynamo the power is 118×576=67,968 watts or 67.97 kilowatts; and this is 67.97÷75=0.906 or 90.6 per cent of its rated load. The big dynamo is, therefore, carrying more than its share of the load which makes little difference so long as both are underloaded, but would not be good policy if both were heavily loaded.

Efficiency of Generating Unit

SUPPOSE that the engine driving the larger machine is indicated to develop 108.5 hp., what is the efficiency of the generating unit?

The watts were found to be 67,968, and dividing this by 746 gives 90.8 electrical hp. and the efficiency will be 90.8÷108.5=0.838 or 83.8 per cent.

Switchboard Efficiency

THIS ought, of course, to be very nearly 100 per cent in a well designed and built apparatus, but cases have been known where overloading the bus bars or loose connections have made the loss in the board considerable.

To get its efficiency, the total power delivered to the leads is divided by the total power received from the generators. In our problem, current is supplied to the following circuits; fan motors 127 amp., hoists 37 amp., mill motors 398 amp., lights 333 amp. and a testing voltmeter shows 118.17 volts at the terminals of the generator leads and 117.98 volts on the buses at the distributing panel.

Adding the delivered currents gives 127+37+398+333=895 amp. and this times 117.98=105,592 watts. From the generators there comes 320+576=896 amp., and this times 118.17=105,880 watts, and the efficiency will be 105,592÷105,880=0.9973 or 99.73 per cent.

Wire Sizes

WHEN alterations or additions are made a frequent question is, "What size of wire shall we use?" It must, of course, carry the current without overheating, but the size is more often decided by the allowable loss of energy or of voltage in the circuit. Smaller than No. 14 wire must not be used because it is too weak mechanically. For main circuits 5 to 10 per cent loss is allowed, depending on the length of the circuit. For taps 1 to 2 volts loss is permitted.

As an instance, a circuit for lighting is to carry 40 16-candlepower lamps, the main line being 150 ft. long and the taps each carrying 4 lamps to be 20 ft. long. For 110 volt lamps, a reasonable allowance is 8 volts in the circuit and 1½ volt in the taps.

For the carbon filament lamps, each one will use 55 watts so that 40 will take 55×40=2200 watts at the lamp; since amperes × volts = watts, watts ÷ volts will give amperes, and 2200÷110=20 amp. required.

To determine the size of wire we make use of Ohm's Law that resistance = voltage ÷ current. In case of a circuit the voltage is the loss allowable or "drop" and 8÷20=0.4 ohm, the resistance of the main circuit. This is for both wires or 300 ft., and to get the resistance of 1000 ft., the value usually given in wire tables, we divide 0.4 by 300 and multiply by 1000. This gives, 0.4÷300×1000=1.333 ohms. The table of values for copper wire shows that the resistance for No. 11 is 1.269 and for No. 12 is 1.601 ohms; but the odd numbers are not used commercially, and resistance of No. 10 is 1.01 ohms. Either one will safely carry the current, so whether to let the loss be more than 8 volts and use No. 12 or less and use No. 10 depends on the taps.

To figure these, 4 lamps will require 4×55=220 watts or 220÷110=2 amperes, and the drop allowed is 0.5 volt, so that 0.5÷2=0.25 ohms resistance for the taps. This is for 40 ft. and 0.25÷40×1000=6.25 ohms. Resistance for No. 18 wire is 6.57 ohms per 1000 ft., but No. 18 is not permitted, so No. 14 would be used, and as this will cause less than ½ volt drop, more than

8 volts may be allowed in the circuit; hence, No. 12 wire would be used.

It is interesting to note that if tungsten Mazda lamps be used, the same light may be had by using 3 25-watt lamps in each of the 10 clusters. This would call for $30\times25\div110=6.8$ amp. for the circuit and the resistance would be $8\div6.8=1.177$ ohms, or $1.177\div300\times1000=3.92$ ohms per 1000 ft., which is smaller than No. 15 wire. The whole system could therefore be made No. 14, more convenient as well as less costly. In addition there will be less expensive fixtures, more lights can be run from the dynamo and the power required is reduced both for lighting the lamps and for loss in the wiring.

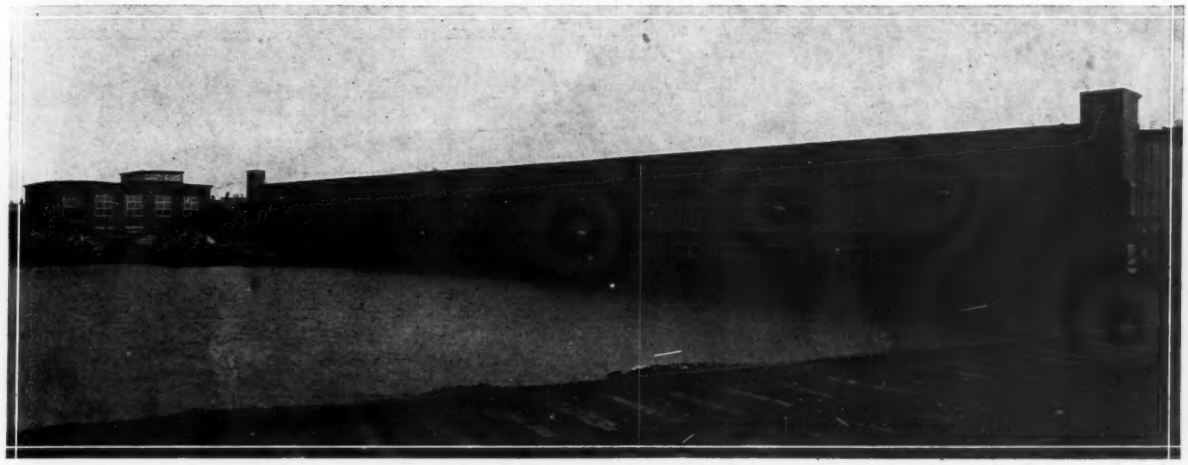


FIG. 3. MAVERICK COTTON MILLS

Motor Wiring

FOR a motor at 750 ft. from the switchboard, a 10 per cent drop is allowed. The power required to drive the fan is 7 hp. and the motor is wound for 530 volts and has an efficiency of 92 per cent. Switchboard voltage in the engine room is 550.

To get the current needed, it is necessary to find the watts taken from the line by the motor; and 7 hp. delivered, at 0.92 efficiency will require $7\div0.92=7.61$ hp. which at 746 watts each gives $7.61\times746=5677$ watts. Divide this by the voltage 530 and $5677\div530=10.7$ amp.

Loss in voltage will be $550-530=20$ volts and this divided by current will be the resistance allowable in the circuit. $20\div10.7=1.87$ ohms. This is for a length of twice the circuit or 1500 ft. and $1.87\div1500\times1000=1.246$ ohms per 1000 ft., which is rather less than that for No. 11 wire so that No. 10 would be used to allow for possible overload.

Loss in Wiring

FREQUENTLY the problem arises to find the loss in power in the wire of a circuit or a winding. If the drop in voltage for a given current be known, this loss in watts will be as already stated the voltage times the current. If resistance of the wire be known, the loss will be resistance times the square of the current flowing.

In shunt wound motor the armature resistance is 0.02 ohm and the field resistance 58 ohms, what will be the armature loss when 125 amperes are flowing and what the field loss when the line voltage is 115?

In the armature the loss will be $0.02\times125^2=312.5$ watts. In the field, the current is found by dividing the voltage by the resistance or $115\div58=1.98$ amp. Then $58\times1.98^2=227$ watts loss.

Going back to the circuit first calculated, which is to carry 20 amp. the wire is 1.601 ohms per 1000 ft. and for 300 ft. it is $1.601\times0.3=0.4803$ ohms, and $0.4803\times20^2=192.12$ watts.

For the taps which carry 2 amp. the wire is No. 14 at 2.565 ohms per 1000 ft. For 40 ft. the resistance is $2.565\times0.02=0.0513$ ohms and $0.0513\times2^2=0.2$ watt loss for each fixture.

One other calculation is frequently necessary, the loss of voltage when a given current flows through a known resistance. In this case, the current times the resistance is the voltage loss.

For the case of the dynamo armature already used, the current is 125 amp, and the resistance 0.02 ohm, so that $125\times0.02=2.50$ volts.

And in the case of the circuits above, the actual drop for the main line is, $20\times0.4803=9.6$ volts, and for each tap the drop is $2\times0.0513=0.1026$ volt.

MAVERICK COTTON MILLS

POWER PLANT AND TRANSMISSION

By H. M. Wilcox

BUILT entirely of reinforced concrete, the new Maverick Cotton Mill in East Boston, Mass., designed by Lockwood, Greene & Co., is perhaps the largest textile mill in this country of this type of construction. Electric transmission is used throughout the mill and a number of interesting problems arose in connection with the installation of the motors and shafting.

Building Details

THE general type of construction of the building is a reinforced concrete framework, columns and floors, with exterior walls paneled with hollow tile. The main mill is 550 ft. long by 130 ft. wide, 2 stories high with concrete girders and concrete slab floor. The weave shed is 340 by 231 ft., one story high, and has a saw-tooth roof. The mill adjoins one side of the weave shed and at the other corner of the same side of the weave shed the power house is located, 91 ft. long by 62 ft. wide overall and divided into a boiler room, 56 by 62 ft. and an engine room, 35 by 62 ft.

The boiler room floor is laid directly on the ground while the engine room floor is supported on concrete girders 12 ft. higher, all the piping, condenser pumps, and the hot well, being located in the engine room basement. The engine room floor is so designed as to be entirely separate from the turbine foundation.

Supported by a steel truss, the roof of the boiler house has a clear span of 56 ft. 6 in. with a monitor 21 ft. 6 in. wide extending its entire length. The engine room roof is supported by a concrete girder which is 3 ft. deep at the center and pitches ½ in. in 12 to the outer walls. The roof of both the boiler and the engine house is a 4-in. concrete slab covered with 4-ply tar paper and gravel roofing.

In the engine room is a 15-ton crane running on 50-lb. rails supported by a 15-in. I-beam resting on heavy pilasters projecting from the columns.

The walls of the power house are made of reinforced concrete frame work, panelled with tile, the greater part of the exterior wall surface being devoted to windows.

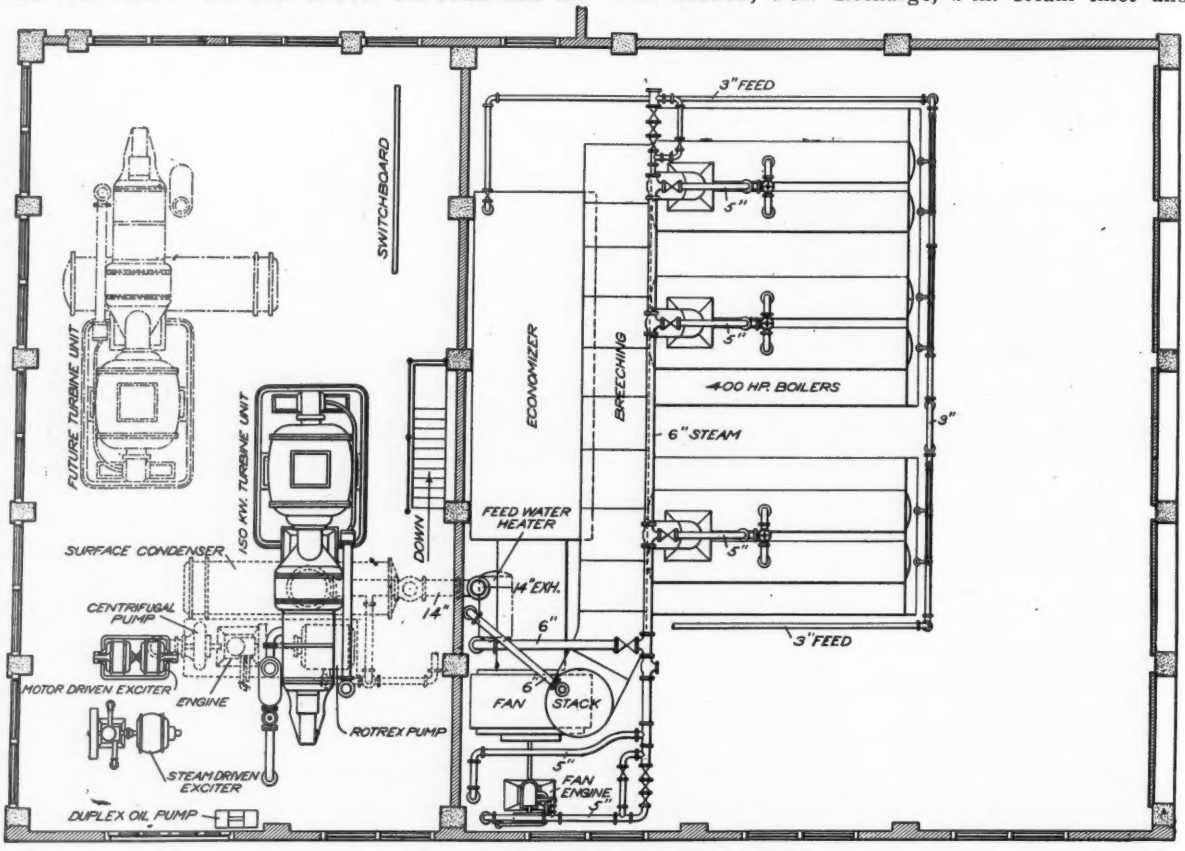


FIG. 1. PLAN OF THE MAVERICK MILLS POWER PLANT

Steam Making

THE boiler equipment consists of 3 400-hp. Edge Moor Iron Works high-pressure, safety water-tube boilers, set in battery. These boilers are built for 180 lb. working pressure and each boiler is equipped with a Foster superheater to give 100 deg. of superheat. This superheater consists of a coil of piping located above the water tubes, and below the drum. One end takes steam from the top of the reheater, drops down in a sweeping curve, passing through the rear fire wall and extending forward to a point well beyond the front of the forward fire wall. It then curves back, passes through the rear fire wall, through a tee upward and out of the top of the boiler near the stack outlet. A long sweeping curve toward the front of the boiler brings it to a riser through which it is connected to the steam main. Each boiler is equipped with a valve so that it can be cut out without interfering with the operation of the other boilers.

B. F. Sturtevant economizer and induced draft apparatus add to the completeness of the plant.

Two 10 by 6 by 12-in. boiler-feed pumps of the Sturtevant duplex outside packed plunger type with 5-in. suction, 4-in. discharge, 2-in. steam inlet and 2.5-in. exhaust draw water from a tank 7 ft. by 2 ft. 6 in. by 4 ft. 6 in., located in the basement of the engine room which receives the condensed steam from the Wheeler condenser. A 3-in. makeup pipe equipped with a float valve supplies this tank. The boiler-feed pumps force the water to the boiler through a Wheeler feed-water heater thus utilizing the exhaust from the auxiliary engines.

Steam Using

THE main power unit is a steam turbine direct connected to an alternator, which with 175 lb. indicated steam pressure and a 28-in. vacuum will show 1500 kw. at 1800 r.p.m. The alternator runs at 300 volts, 3-phase, 60 cycle.

In addition to the turbine generator there is located in the engine room one steam driven exciter set and one motor driven exciter set, all of these together with the switchboard, being furnished by the Allis-Chalmers Co. The turbine and generator occupy the floor space aproximately 30 by 8 ft. and weigh complete 111,300 lb. The turbine exhausts through a 32-in.

pipe to a Wheeler surface condenser located in the basement. This condenser was manufactured by C. H. Wheeler Mfg. Co., Philadelphia, Pa., and is equipped with a centrifugal circulating pump, having a 14-in. suction and 12-in. discharge, also a Pratt Rotrex pump with 10-in. connection from the condenser and an 8-in. discharge. These 2 pumps are directly connected, one either side of a 9 by 9-in. vertical engine. Salt water is used for condensing purposes.

Steam supply for the turbine is by a 6-in. line from the main steam line in the boiler room to a separator designed by Lockwood, Greene & Co. and from the separator through a 7-in. line to the throttle.

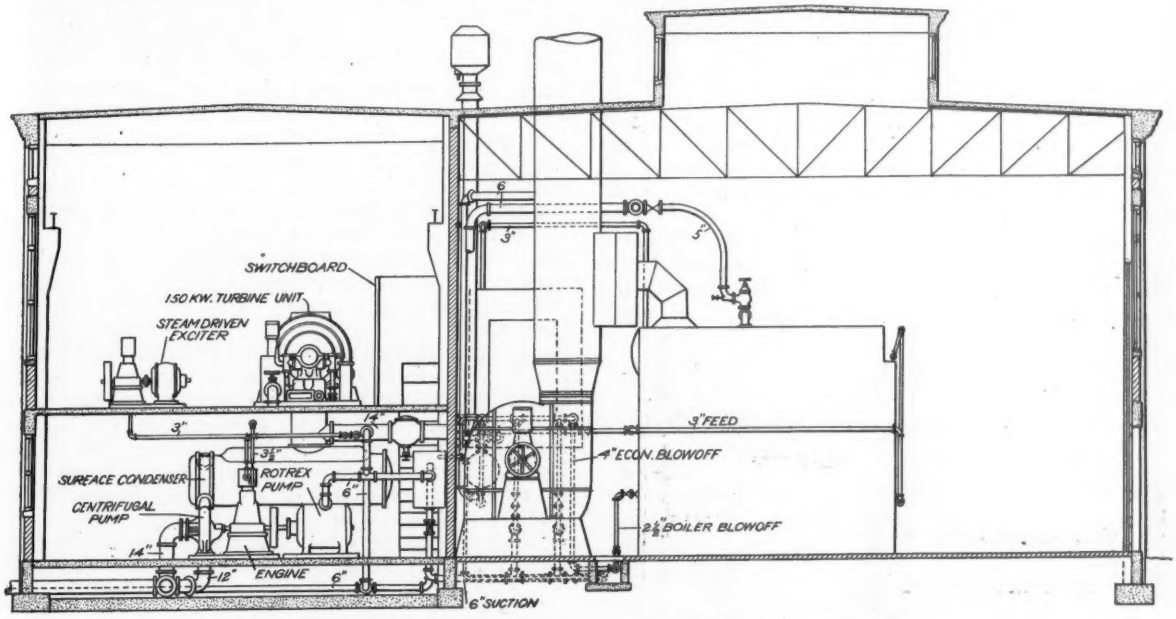


FIG. 2. MAVERICK MILLS POWER PLANT, SECTIONAL ELEVATION

Attached to the exhaust from the turbine before it enters the condenser is a 14-in. line which passes through a 14-in. water seal relief valve and this through a riser to an exhaust head located above the roof. The exhaust line from all the auxiliaries is also connected with this relief line. In the basement of the engine room is located the 1500 gallon circulating pump.

Machinery and Drive

IT was found that on account of the high frictional resistance between the concrete floors and the bases of the machines on a large part of the lighter running machinery 2 or 3 expansion bolts placed in holes drilled in the concrete floor were all that were necessary. As an example of the saving in labor which was effected in attaching machines on the spinning frames where in a wooden and brick mill, 22 lag screws would be required to attach a frame to the floor it was necessary to use only 6, 2 at the head, 2 at the tail, and one at either side 1-3 from each end.

All machinery is driven by electric power, the motors being suspended from the ceiling by especially designed frames with the exception of 4 100-hp. floor motors located in the basement of the weave shed which drive the looms. In regard to the latter, each motor drives 5 lines of shafting which extend the entire width of the weave shed. Looms are driven direct from this shafting by belts passing through holes left in the concrete floor, the proper arrangement of the floor reinforcement so as not to weaken the floor and not interfere with the locating of the belt holes requiring careful designing. Weave shed shafting is supported by ordinary wall hangers to the concrete columns, vertical strips of wood 5 in. high by 1 in. thick and extending entirely through the columns being embedded in the concrete at the points where the shaft hangers were to be attached. Holes were bored through these strips and the shaft hangers bolted directly to the column.

In the spinning mill where the motors were suspended from the ceiling, horizintal bolt holes were left in the girders at points where the motors were to be attached. Wrought iron plates were securely bolted either side of the concrete girders and to these plates were riveted angles to which channels were attached extending from girder to girder, the motors being then slung by heavy bolts from these channels; for the larger motors, angle braces were used to stiffen the framework.

An interesting method was developed for driving the spinning frames. Each motor in the spinning room was equipped with a double pulley on each end of the armature shaft. In place of a flange to separate the belts the crowning of each section of the double pulley was made ¼ in. away from the middle of the pulley, so that the belts are kept apart without danger of their climbing a flange and being thrown off. Furthermore, the belts can be shifted from the tight to the loose pulley on the spinning frame without being thrown off the motor pulley. All shafting and the motor supports were supplied by the Jones & Laughlin Steel Co., Pittsburg, Pa.

The use of reinforced concrete for this mill is a decided step in advance and should cause other mill owners to consider seriously the adoption of this type of construction for any new plants. Erection was supervised by Lockwood, Greene & Co., of Boston, Mass., and the contract for the mill building was executed by the Hennibique Construction Co., of New York City, while the office building was built by J. W. Bishop.

PRACTICAL OPERATION OF THE ABSORPTION SYSTEM OF REFRIGERATION

By Walter C. Edge

MUCH MORE ATTENTION IS required with the absorption system of refrigeration than with the compression system, to obtain the best results. The parts needing the closest attention are, the expansion valve, the valve controlling the weak liquor supply, the valve regulating the steam pressure and the valve which controls the water supply to the rectifying tank. Any of these 4 valves if not set exactly right, may cause the machine to lose ground. If the expansion valve is open too wide, the cooler becomes overcharged, and a great deal of the charge falls to the bottom of the cooler; on the other hand, if it is not open wide enough, there will not be sufficient gas to lower the temperature of the brine.

The weak liquor valve, if open too wide will cause the absorber to become hot, and this heat will act on the cooler offsetting the work of the gas, causing the brine to lose temperature rapidly; again, if the weak

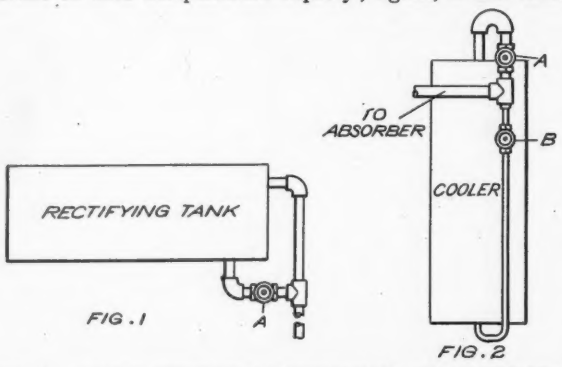


FIG. 1. WATER DISCHARGE CONNECTIONS FROM RECTIFIER
FIG. 2. METHOD OF PURGING COOLER

liquor valve was not open wide enough, there would be insufficient liquor to absorb the gas as fast as it entered the cooler, consequently there would be a great deal of back pressure in the cooler, and the expansion of the gas would not be rapid enough to absorb the quantity of heat it should and the brine would suffer again.

The steam valve to the coil in the generator, may cause considerable trouble if not open wide enough, allowing the steam pressure to fall off. If this takes place, there will be insufficient heat to drive off all of the gas from the incoming strong liquor, and the liquor in the generator will become stronger than it should be, thus interfering with the absorption process as follows: The weak liquor going to the absorber containing 18 per cent ammonia, will absorb about 10 per cent, making its strength 28 per cent when leaving the absorber, therefore if the weak liquor goes to the absorber 23 per cent in strength, it will absorb only 5 per cent, again affecting the cooling process by back pressure in the cooler. The valve controlling the water supply to the rectifying tank is even more important; this may cause the same trouble by being open too wide as the steam valve does by not being open wide enough. When the valve is open too wide the water in the tank becomes too cool, and the water that is supposed to condense moisture in the gas and send it back to the generator condenses a great deal of gas also, and this condensed gas, going back to the generator, strengthens the weak liquor, and the same trouble again exists.

On the other hand, if this valve is cut off too much, the water becomes too hot, and when this happens, your rectifying tank is useless, as the moisture goes through with the gas to the condenser, and then your gas is weakened. This not only weakens the ammonia, but it clogs up the cooler to a certain extent, as the moisture will go to the bottom of the cooler.

It happens sometimes that the water in the rectifying tank is the right temperature, and still the trouble is traced to this section of the machine. If such be the case, look for mud in the bottom of the tank. If the water is dirty, this mud may become so deep that it will very nearly cover the coil, and every time you have mud there you have heat, sometimes the mud becoming so hot as to make it impossible to put your hand in it. In a case of this kind you may as well pump your cooling water to the drain as to the rectifier. Prevention is always better than cure, therefore something should be done to keep too much mud from settling in the tank. It is a good idea to have the rectifying tank connected as shown in Fig. 1, then it can be kept thoroughly clean, by opening valve A occasionally, and giving it a cleaning from the bottom.

Although these 4 parts need the closest attention, there are many minor things to be looked after.

Too High Back Pressure

IF the absorber and cooler gages show a high back pressure, it signifies that something requires attention; possibly the absorber is not getting a sufficient supply of cooling water. If this is the case, and the water supply is limited, you can cut down a little on the supply to the condenser, thereby sending more through the absorber, and by watching the head pressure closely you can readily see whether or not the condenser has enough supply. Of course, this would not be possible where the water must first pass through the condenser to reach the absorber.

It may be air in the absorber causing the back pressure; in this case, the air may be removed through a little purge pipe, tapped into the side of the absorber, about 1 ft. from the bottom. Care should be exercised in relieving the air, as considerable good gas may be lost through carelessness. Connect the purge pipe to a bucket of water and open valve carefully; good gas will make a noise similar to steam blowing into the bucket, and the moment this sound is detected, the valve should be closed. It is advisable to let the weak liquor run up in the absorber as high as the purge valve during the operation, as all the air, which always goes to the bottom may be raised sufficiently in this way to pass out through the valve. The high back pressure, again, may be caused by having a heavy charge in the cooler, which may be remedied by cutting down on the expansion valve.

If the cooler had the bottom filled with liquid ammonia, due to the expansion valve being open too wide, or the rectifying tank being too hot, the back

pressure would be high once more. To reduce it when caused by this, it would be necessary to purge the cooler, which is done by closing the gas line from the cooler and opening the purge line as shown in Fig. 2, A being the gas valve, and B the purge valve. It is possible to purge the cooler, leaving valve A open during the operation, the advantage being, that the machine is working and being purged at the same time, the disadvantage being in the time required to purge it.

If it is necessary to purge the machine very quickly, it can be done by opening the small valve which connects the cooler and condenser, thus allowing the condenser pressure to act on cooler, but this is not advisable, as it causes the machine to go back too much. It is better judgment to open the weak liquor valve wider than usual while purging the machine, so as to make sure of having enough go to the absorber to absorb all the gas, as a great deal of trouble may be caused by getting the ammonia pump gas bound, by drawing gas into the cylinders.

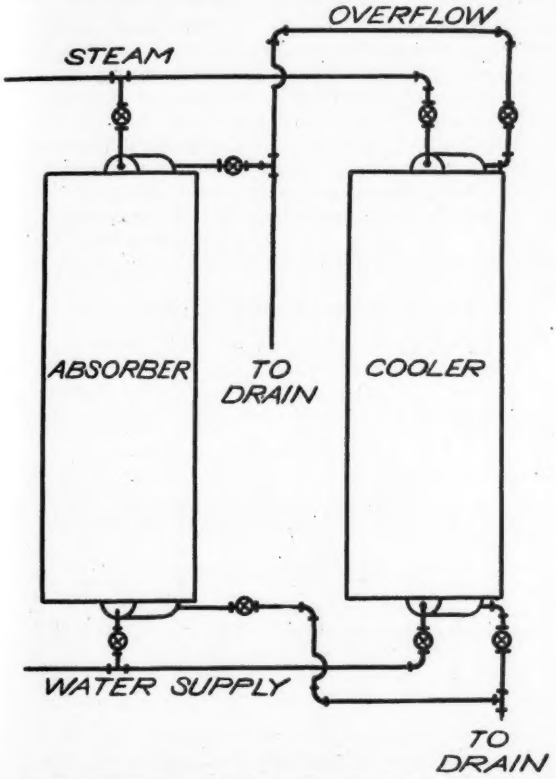


FIG. 3. PIPING FOR CLEANING ABSORBER AND COOLER COILS

As the pump was made for liquid, and not for gas, it will not pump the gas, and if gas gets into the cylinders the pump will fail to work until relieved of the gas, therefore it is well to have a method of relieving the pump in case of necessity. A good plan is to have an extra valve from the discharge pipe to the atmosphere; then in case the pump becomes gas bound, this valve can be opened, and the gas discharged into a bucket of water.

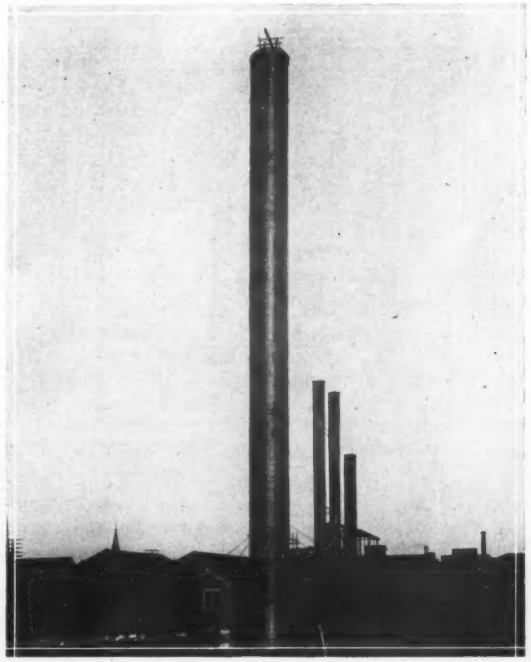
Clogged Coils

IN some cases, especially where the cooling water is a little dirty, the coils in the absorber and condenser become partly clogged, and if this happens, it is sometimes necessary to send twice as much cooling water through to perform the same work, and in some exceptional cases, it is impossible to do the same work, regardless of how much water is sent through, so you can readily see how important it is to keep the coils clean.

In Fig. 3 a very good method is shown for cleaning the coils. Make a permanent steam connection to the upper manifolds, putting gate valves in the overflow line, and connect lower manifolds, using valves to separate them, and piping them to the drain. The steam blowing through in the opposite direction from that taken by the cooling water will cleanse the coils thoroughly, but of course it is necessary to let the ammonia charge into the cooler during the operation, as the steam would heat the ammonia, causing the head pressure to become excessive.

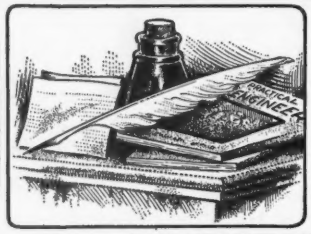
A BIG STEEL STACK

HEREWITH is illustrated a large stack recently erected by the Canton Boiler & Engineering Co. for the Canton Electric Co., Canton, Ohio. This stack is 250 ft. high by 16 ft. 3 in. inside diameter, of the self-supporting type, held in position by 24 foundation bolts each 3 in. in diameter and 18 ft. long. It contains approximately 175 tons of steel, is 24 ft. in diameter at the bottom, tapering up for 20 ft., at which point it is 16 ft. 3 in. in diameter, which it keeps to the top.



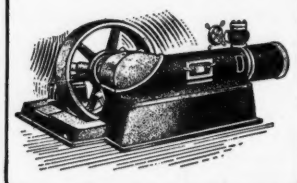
STEEL STACK OF THE CANTON ELECTRIC CO.

The stack is equipped with a ladder and a track around the top on which a wheel travels for rope blocks to be used by painters. It is to be lined its entire height with 6-in. firebrick, these bricks or blocks being in circular form to fit the stack. The chimney will take care of the gases from 11 450-hp. B. & W. water-tube boilers, which will be connected to it through a breeching 20 ft. by 10 ft. The cost to the Canton Electric Co. was approximately $20,000, including foundation, but not the lining.



Letters from Engineers

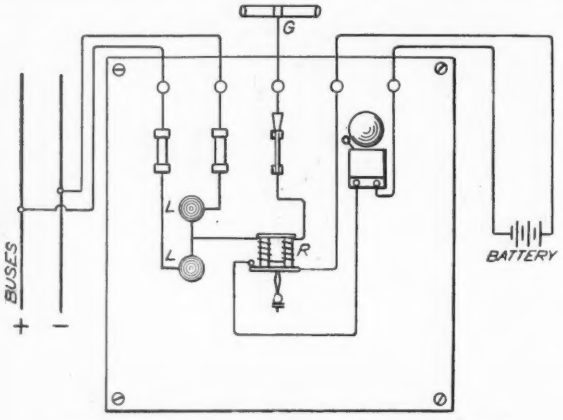
Bright Ideas direct from the plant. Send us yours. Cash paid for those accepted. Sketches desirable; we make the drawings



ALARM GROUND DETECTOR

THIS summer I made an electric alarm ground detector, as the engineer of the plant was not always aware of a ground, and the only way he knew was to test with his voltmeter, on his switchboard he had a voltmeter switch with 8 points, 3 are used for 3 generators, and 2 are used as a ground detector. He had the switch set for the line voltage, and only when he thought of it would he test for a ground.

I enclose a diagram of the alarm ground detector as it may be of use to some engineer. The idea is to connect 2 lamps of the same voltage, 16 candlepower, in series across the busbars of the switchboard. Make



CONNECTION FOR ALARM GROUND DETECTOR

a connection between the 2 lamps and connect to one side of the relay about 20 to 30 ohms resistance, the higher the resistance the more sensitive the relay is; on the other side of the relay connect to a switch connected to ground. The armature of the relay is in circuit with the bell. When the ground comes on, by opening the switch the bell stops ringing and the ground can be found. W. O. Davis.

USEFUL BULLETINS AND CATALOGS

I READ every issue the interesting Books and Catalogs column in Practical Engineer and find that in the October number especially attractive. I have followed this column carefully for a number of years and find it as important and helpful as the rest of the paper. The striking feature is the impartial advice to readers as to the value of different bulletins for distribution.

These catalogs are instructive and give good information on different subjects upon which they treat, frequently containing a great number of engineering information aside from the descriptions of apparatus. As a result of writing to manufacturers I have my name on 3 or 4 mailing lists of some of the largest makers in the country and receive the different bulletins as soon as they are published. They come perforated at the back ready for filing, and when they are filed form a most valuable book of reference.

Especially I use those of the General Electric Co., Sprague Electric Co., Westinghouse Companies and the American Locomotive Co., and take great interest in them. These companies maintain up-to-date mailing lists and recipients of the bulletins will always find something valuable in them. Russel R. Ux.

DRILLS FOR TAPS

TO the engineer who does his own repair work the accompanying table is a convenience well worth preserving. It gives the size drill to be used in making a hole to be tapped for a bolt of given size.

TABLE OF DRILLS FOR TAPS

FOR BOLTS				FOR PIPES	
SIZE OF TAP IN INCHES	SIZE OF DRILL TO USE, INCHES	SIZE OF TAP IN INCHES	SIZE OF DRILL TO USE, INCHES	SIZE OF TAP IN INCHES	SIZE OF DRILL TO USE, INCHES
1/4	5/16	7/8	25/32	1/4	15/32
5/16	1/4	15/16	3/4	3/8	19/32
3/8	9/16	1	27/32	1/2	3/4
7/16	11/32	1 1/8	15/16	3/4	1
1/2	15/32	1 1/4	1 1/16	1	1 1/4
9/16	7/16	1 3/8	1 3/32	1 1/4	1 17/32
5/8	1/2	1 1/2	1 9/32	1 1/2	1 13/16
11/16	9/16	1 5/8	1 3/8	2	2 1/4
3/4	5/8	1 3/4	1 1/2	2 1/2	2 3/4
13/16	21/32	2	1 23/32		

For preserving tables of this kind about the plant, I paste them on a light board of convenient size, then give the entire face a coat of white shellac; this renders it washable and protects it from wear.

B. A. Held.

WHAT I SAW

NO wonder we need license law in Pennsylvania, for here's what I found in one large power plant and it is not different from many others in the state. I went there to run an engine in the plant and the first morning I walked into the boiler room and looked at the water columns. They looked queer to me and says I to the fireman: "How often do you blow your gage glass?"

"Oh, I never blow it."

"And how often do you try your gage cocks?"

"Oh, never try anything. Everything is all right."

Well, I told him to go try them and he said he didn't dare. The other engineer never looked at them and never told him to try them.

In that plant they run 4 250-hp. Stirling boilers, 3 being in use and 1 idle for supposed cleaning. I concluded it was time somebody looked at those gage cocks, so I went myself to see whether all were in good condition, and I had to get a heavy pair of pliers and a piece of copper wire and work 10 minutes at the pet cock under each water column to get any

water through. Then on trying all the gage cocks I found only one on all 3 boilers in working condition and that was a top one and in the steam space. It looked to me as if they were not blown for several months as they were choked up and coated with soda ash so that they could not be moved with a hammer.

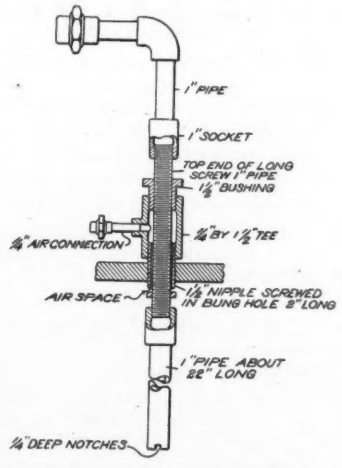
Next I climbed on top of the boilers and found that to open and close the main stop valve on the boiler they used a piece of pipe 3 or 4 ft. long and you had to pull hard to get the valves open. The same was true of the safety valves. They were cutting down expenses all right, but they were also cutting down the plant.

Where was the trouble in that plant? All the firemen were foreigners and even the former engineer, and all they had done was to throw coal under the boilers and open the steam valves to start the engines. When they packed the pump they would put in the packing and then pull with all their might on a heavy wrench to make it fit the cylinder, and it wasn't much fit at that; and they used a new water plunger about every 3 months.

There were 2 large medium speed engines which ran away several times, nearly killing a few men. So we examined the governors, and we found that half the oil holes were stopped up so that they never got any oil for several months. They were choked with hard dirt so that they had to be dug out with a sharp pointed wire. It was a good way to get work out of the engine. When I questioned one of the assistant engineers about oiling those holes and told him to do it, he said: "Oh, those don't hurt. They've been that way all the time." Does this seem as if engineers ought to be licensed? A. A. R.

OIL TRANSFERRING

YOU will find enclosed a rough sketch of a very convenient article, used to transfer oil from a barrel to a tank. Use an air hose for convenience in making temporary connections each time used; 4 or 5 lb. of air will suffice to do the work, where high



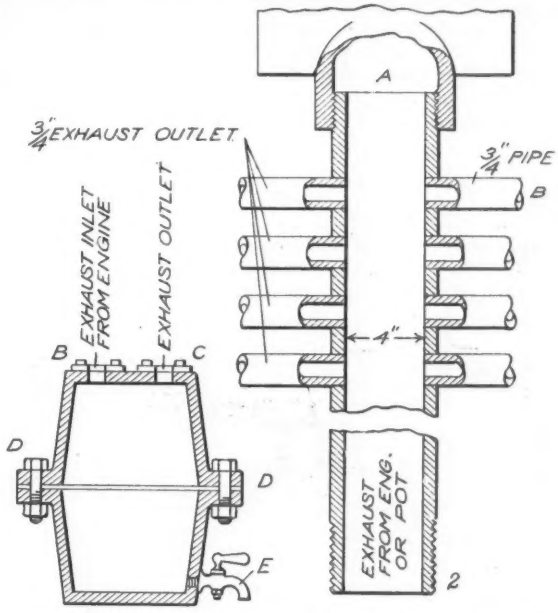
PIPE FOR TRANSFERRING OIL

pressure air is used do not put on a heavy pressure, as pressure is direct on the barrel and will cause leaks through the staves. I would not be without it, having a great deal of oil to transfer. M. W.

A POUND IN AN engine has cost many a man his position but eventually made an engineer of him.

MUFFLER FOR GASOLINE ENGINES

IN the accompanying illustration is shown a home-made muffler which we constructed for a 20-hp. gasoline engine. It gives effective service in eliminating the sharp, penetrating quality of the exhaust noise without causing appreciable back pressure. The sides of the main 4-in. exhaust pipe are drilled and tapped for 3/4-in. pipe; screwed into these holes, of which there should be from 10 to 16 according to the size of the engine, are 3/4-in. pipes 6 in. in length. These



MUFFLER AND EXHAUST POT FOR GASOLINE ENGINE

pipes are attached near the end of the exhaust pipe for a distance of 4 or 5 ft., and a tee is secured at A on the outlet of the main exhaust.

In our case, the main exhaust is attached to the engine through a cast-iron exhaust pot, also shown in the illustration. This is made in 2 sections bolted together by means of the flanges shown at D, sheet asbestos being used for packing this joint. Exhaust from the engine is attached directly to the inlet, B, of this exhaust pot and then the main exhaust pipe is attached to the outlet, C. The method of fastening these is by means of screw flanges and stud bolts as shown in the illustration. The exhaust pot is 18 in. in diameter and 24 in. high. It is provided with a drip cock to relieve it of any water which may collect at the bottom. The exhaust pot should, of course, be as near to the engine cylinder as possible and attached in such a way as to give the force of the exhaust downward.

The exhaust gases pass from the pot into the main 4-in. pipe and the sound is deadened by taking in air from the sides or letting out the exhaust in such a way as to eliminate the disagreeable noise of the discharged gases. J. A. L.

CARE OF UNUSED BOILERS

IN answer to the question asked by H. M. S. in the October issue of Practical Engineer in regard to the Care of an Unused Boiler, I offer the following suggestion:

There are several ways of keeping a boiler, that is not to be used for some time, in good condition.

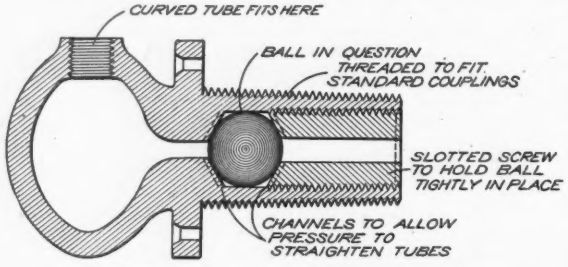
One method is to fill it completely full of water in which a quantity of common washing soda has been placed. Another good method is to empty the boiler and dry it thoroughly as suggested by H. M. S. and then place trays of quicklime in the bottom to take up any moisture that might be present. When using this method the boiler should be sealed as nearly air tight as possible to keep out dampness.

As the boiler in question is to be idle only one month it is not likely that any harm would come from simply letting it stand with water to the working level, but this would depend somewhat upon the condition of the boiler. It is always best to be on the safe side and if either of the above named methods can conveniently be used it would probably be a saving in the end to take the extra precaution.

S. Hurley.

CURIOUS GAGE CONNECTION

IN taking down a high pressure gage, I found in the connection which screws into a fitting a ball about 3-16 in. in diameter with 2 small channels cut by it in the direction that the air would pass into the


CURVED TUBE FITS HERE
BALL IN QUESTION
THREADED TO FIT STANDARD COUPLINGS
SLOTTED SCREW TO HOLD BALL TIGHTLY IN PLACE
CHANNELS TO ALLOW PRESSURE TO STRAIGHTEN TUBES

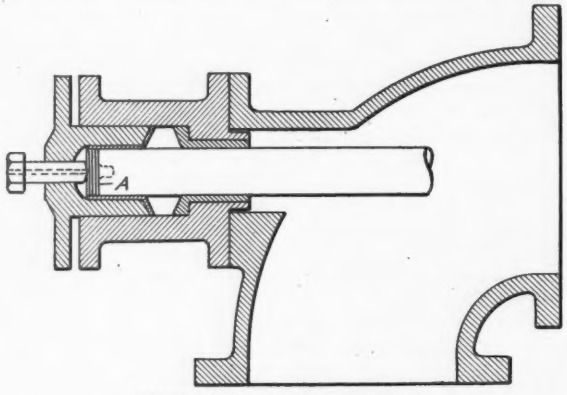
CONNECTION TO AIR PRESSURE GAGE

tube, this ball was held in by a screw with a hole in it and seems partly to obstruct the passage of air but for these small channels.

This gage is on an air line and reads to 5000 lb. The pressure carried is 2500 lb. The face has upon it the word "Hydrostatic." What I want to know is the function of this restriction.—Wm. P. Harty.

CENTRIFUGAL PUMP BEARING

WE had a large 3-stage centrifugal pump which had no outside bearing for the runner shaft and as it was always carrying a full load, the strain on the shaft



CENTRIFUGAL PUMP BEARING

was very great and the bearings were continually causing trouble.

The accompanying sketch shows how we remedied the trouble by simply changing the elbow in the suction pipe. Not only was the shaft relieved of a great strain but also naturally ran more smoothly. The only part which wears and requires replacing is the brass spacers A. The shaft running through the elbow did not decrease the suction area to any appreciable extent. The cost of the new casting was small compared to the advantage of having a smooth running pump.

R. A. Anderson.

CRUDE OIL BURNER

REPLYING to F. G., page 631 of Practical Engineer, I wish to say that California housewives have been using crude oil and No. 2 distillate in cook-stoves and heaters for over 10 yr. The oil is simply fed by gravity from a tank outside the house to a special burner in a brick lined firebox.

I believe the suggestion of F. G. is impractical and unnecessary. From my experience in burning oil I would prefer dry steam or none at all.

Louis F. Scribner.

BINDING PRACTICAL ENGINEER

AS this is the last copy of Practical Engineer for this year, thus completing Vol. XIV, some of the readers are, no doubt, beginning to think about how they are to preserve their copies for future use. I thought a brief explanation of how I bound my last volume might be of service.

Place the copies one on top of the other so they will be in correct order, and with the index at the front. Lay them on the work bench, with a paper under them to keep them clean; and place a board on top of them, leaving about a half inch of the back margin uncovered. Get them arranged evenly at the back edges, then place a heavy weight on top of the board that covers them, or better still, procure 2 clamps and clamp them to the bench. Cut the head off of a 10-penny nail, and file the point down sharp. This makes an excellent tool, when clamped in a carpenter's vice, for drilling the holes. Now locate the holes about ¼ in. from the back edge; starting with one ¾ in. from the end, make one every 1¾ in. Just as fast as a hole is finished a nail should be dropped through it.

When the holes are all finished take some twine and a large needle and stitch the copies together removing the nails from the holes as fast as the twine is ready to be passed through them. Draw the stitching real tight before making it fast. Now remove all the loose glue from the back edge of the book, and give it about 3 coats of fresh glue, waiting each time for the previous coat to dry.

A good back may be made from a piece of tagboard, which may be obtained from any printing office for 5 or 10 cents.

After cutting the tagboard the proper size for the cover, measure the thickness of the book, and by the aid of a steel square make 2 creases at the center. Now give the back edge of book another coat of glue, coming up on the margin, as far as the stitching. Also paint the back between the creases with glue, then carefully place it on the book, pressing it well in where the glue is so that the entire surface will stick, and hold it there until the glue is well set.

To prevent the back from breaking loose when the book is opened, a crease should be made near where the cover is glued to the book.

If considered necessary the edges of the pages

may be trimmed by taking it to a printing office, this, however, is hardly necessary, as Practical Engineer is always nicely trimmed before it is sent out.

The front cover may be made to look very neat by preserving the front cover of the January issue and pasting it over the tagboard forming the front cover.

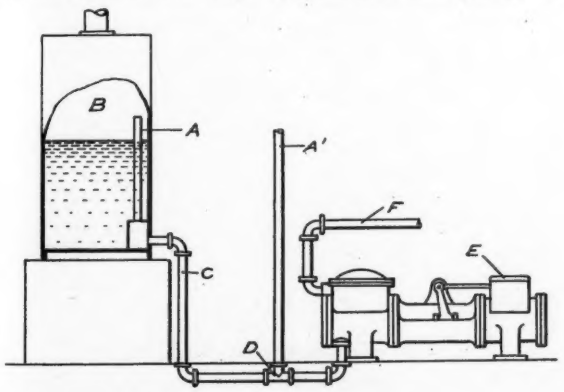
This makes a handsome book which the writer would not dispose of for $5.00, and yet it costs just $1 or 2 for $1.50. J. M. Row.

POUND IN PUMP

I NOTICED an article in a recent number of Practical Engineer written by H. C. M., about a pound in a pump. The article relates an experience a great deal like one of my own.

In the sketch herewith the reader will see how our pump is connected. It is a Fairbanks-Morse duplex, 7 by 4½ by 7 in. feeding a battery of 7 boilers of about 70 hp. each. These pumps, we have 2, take water from a Cochrane heater, B, which is placed about 4½ or 5 ft. above the suction, C, of the pump E. A., A′ are vapor pipes, A being ½-in. and A′ connected in tee D, is 1-in.

After the heater has been run about 3 or 4 weeks vapor pipe A will stop up and then the pump will



PUMP CONNECTIONS TO HEATER

not take the water satisfactorily above 180 deg. When this vapor pipe is open the pump will handle the water nicely at 208 or 210 deg. and will not pound. We have no air chamber or check valves on the discharge line, except the checks at each boiler.

L. J. B.

WHO WAS TO BLAME?

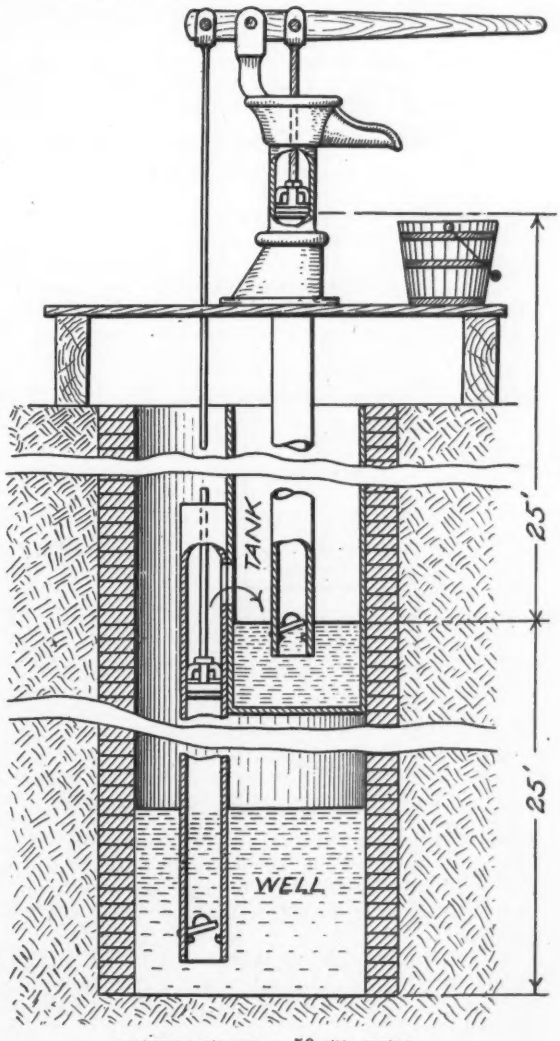
IN Practical Engineer of September I find an article with the above title among the letters from engineers. In the writer's opinion the chief engineer was to blame for not appreciating the long and faithful service of a subordinate enough to give him the 2 or 3 weeks' vacation he asked for, when his purpose in asking for the leave of absence was to regain his health. Doubtless this same chief engineer had been having his 2 or 3 weeks' vacation every year and enjoying himself to the fullest and never gave the poor subordinate a single thought, forgetting that he was a piece of human machinery like himself and would not run forever, but needs to go to the repair shop. This chief engineer needs a dose of his own medicine to bring him back to where he belongs. I am glad my employer is not of that kind.

The assistant engineer was to blame in 2 ways, first for getting drunk, which not only did not mend matters, but hurt his reputation as a sober and industrious man earned by his previous record, and second, for waiting long enough to give the chief a chance to fire him.

In the writer's experience men of the stamp of this assistant, as far as faithfulness goes, are very valuable men to have around and are deserving of a great deal of consideration. It relieves a chief engineer's mind a great deal to have a man he can trust who will be faithful to him in his absence as well as in his presence. F. M.

LIFTING FROM A DEEP WELL

IT is commonly accepted by technical authorities that a pump cannot lift water over 30 ft. theoretically and over 25 ft. practically. That, of course, is true for a pump with a single suction, but here is how my grandfather beat the game and made one



LIFTING FROM A 50-FT. WELL

pump lift water 50 ft. It may be not according to the rules of the theory to use 2 suction cylinders to a single pump, but it did the business and it is an idea which might be applied in almost any case under similar conditions, whether the pump were hand operated or steam driven. G. G.

COST OF 0000 WIRE

REFERRING to W. H. Keller's article in the October issue in which he states the cost of a pair of 0000 wires, 1 mile long, would be only $192, I think he has got 0000 mixed up with No. 4. Two miles of 0000 copper wire weighs 6750 lb.; and this at 15c per lb. would cost $1012.50.

Two miles of No. 4 copper wire weighs about 1325 lb.; and this at 15c per lb. would cost $198.75.

John Craig Scott.

GATE VALVE EXPERIENCE

WE had an 8-in. gate valve that required a new gasket between body and bonnet. The valve was located at the bottom of the suction tank, between the pump and tank, so it was necessary for us to renew the gasket without taking the bonnet and gate

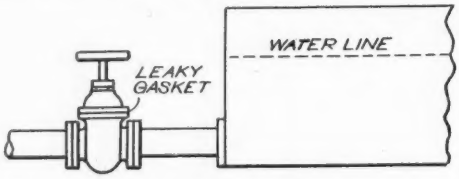


FIG. 1. LOCATION OF VALVE

from the valve in order to save the 2500 gal. of water which contained an oil emulsion.

We closed the valve, then took out all but 2 of the ⅝ by 3-in. bolts holding the bonnet on the valve body. We then procured 2 ⅝ by 4-in. bolts, which were put in opposite holes and took out the remaining 3-in.

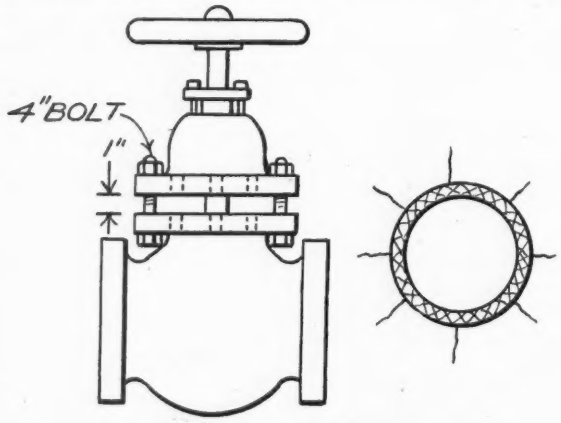


FIG. 2. METHOD OF REPLACING GASKET

bolts, slacked off on the 2 4-in. bolts, following up with the valve wheel, keeping the gate in the seat, and gradually raised the bonnet an inch from the body, which gave us ample room to clean off the old gasket.

We then braided a gasket out of 18 strands of Palmetto twist packing making a gasket about ⅜-in. in diameter, which we slipped around the joint inside of the bolt holes.

We then tied light twine at intervals of about 4 in., in order to pull the gasket tight against the bolts, then spliced the gasket, wrapping the joint well with light twine.

Next we slacked off on the valve wheel and followed up with the 4-in. bolts until we could get the nuts caught on the 3-in. bolts. We then took up on all bolts and when they were tight our gasket had squeezed down to about the same thickness as the original flat gasket. A. J. Zimmerman.

AIR PRESSURE FOR AIR LIFT WELL

TO find air pressure required to start water with an air lift; multiply the number of feet from top of water to top of discharge by 0.44, multiply the number of feet from top of the water to bottom of air line by 0.22, add the 2 products together, the sum will be the required pressure. Try this, it is simple and easy to remember. H. T. Fryant.

BELT QUERIES

IN regard to the belt questions asked in the November issue, I have used belts in the churn room of a large creamery where there is much moisture and have found that Gandy woven cotton beltings last longer and hold better on the pulleys than any other when they were very wet. I have also used this on a steam threshing machine, 6 in. wide and 5 ft. between centers, and found that in almost every instance of a sprinkling rain storm other belts would slip and fly off, while the canvas would hold and keep pulling. This led to using it in the creamery.

I don't much like the laced leather for splicing belts as it is low in tensile strength compared with the whang leather or dog skin from which most belt lacing is made. Where cement or wire lacing or riveted belts cannot be used the dog skin gives as good service as can be expected. Leather belting laced with wire will make almost as smooth a joint as cement, but in time the wire will wear through in passing over the pulleys. The wire used should be soft annealed composition resembling brass. It is put up in packages with full directions for making a splice and can be obtained at almost any supply house. R. A. Cultra.

WATER LEAK IN PLUNGER

THE article "Didn't Know It was Loaded," in the September issue, recalls an experience with a pump plunger on a Gaskell pumping engine. Plunger is shown in Fig. 1, a hollow metal cylinder with heads fastened on by means of studs, the plunger rod run-

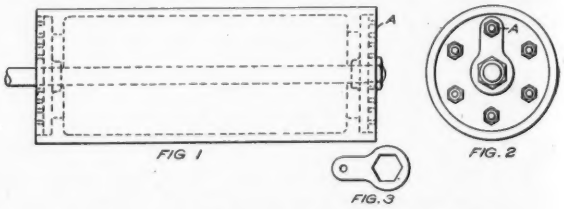


FIG. 1. PUMP PLUNGER WHICH LEAKED
FIG. 2. PLUNGER HEAD
FIG. 3. CLIP TO HOLD NUT

ning through and locked with a nut. A thin iron clip, Fig. 3, slips over the nut, and one of the studs to prevent the nut from working off as shown in Fig. 2. This clip having become rusted through was to be replaced with another, so the nut on the stud A was unscrewed. The stud came out with it, as did also a volume of water, somewhat alarming and soaking the man who was doing the work. This plunger was supposed to be absolutely watertight, so I think it is probable the water must, in course of years, found its

way through the iron, similar to the case of the piston head mentioned. The water pressure is from 90 to 130 lb. Tom Jones.

AN ENGINE WRECK AND ITS SEQUENCE

WHILE repairing a machine on the second floor of the planing mill where I am employed as engineer and general repairman, I suddenly realized that something was wrong and rushed for the engine room, but on arriving there found nothing but a cloud of steam. I crawled in near the floor and shut off the boiler feed, closed the throttle valve and started to pull the fire when my fireman came in.

When the steam cleared away I found a wreck; the engine was minus the belt wheel, there were 2 large holes in the roof, one over where the belt wheel had been and the other in a direct line with the wheel, about 15 ft. away. The section of wheel which made this second hole struck the driven pulley, knocked a hole in it and bent the shaft and yet had force enough left to go through the roof and was found lying thereon.

A third section went through a window in the other direction, tearing out brickwork and flattening pipes on its way, and was found imbedded in the ground in a field on the other side of the road.

The power house is a 1-story structure at 1 end of the mill. In the mill next the engine room was a 48 by 10-in. wood pulley, driving an exhaust fan at 1500 revolutions. This pulley had been lagged up from a 46 in. and it went to pieces, throwing chunks in every direction, and although men and boys were passing by almost continuously to and from the deep well pump for drinking water, and the pump is right in line with the belt wheel under the main driven pulley, yet nobody received as much as a scratch. I escaped by running outside the mill instead of through, when I reached the bottom of the stairs which end at the side door of the mill, the distance being no greater and the going better.

The engine bed was broken through in 2 places; when we took it out it was 3 pieces of scrap iron. It was a common slide valve engine, 12 by 16 in., running 160 revolutions, and had no safety device of any kind on the governor.

After the wreck the governor was in good shape, but its belt was in several pieces, as was the driving belt; my conclusion was that the governor belt had broken, although it had not shown any signs of weakness. Had there been a load on the engine this would not have happened, as the engine was heavily overloaded at times. The fan pulley must have gone first as even that held it down pretty well.

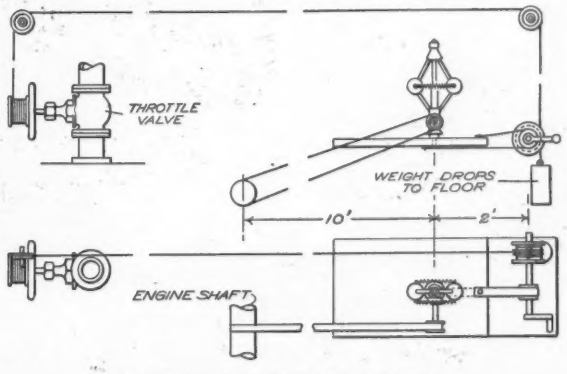
Well, in 10 days we had another engine installed and running; it is a 4-valve, 14 by 24-in., speeded up to 100 r.p.m., bought in a hurry from a second hand dealer, and since has had cylinder and guides rebored, new piston with packing put in, main pedestal Babbitted, all pins on governor and valves renewed, and a 1-piece wrist pin put in. As soon as I saw this engine I realized that the danger of racing and going to pieces was just as great with it as with the slide valve, so asked for an automatic engine stop, but owing to cost did not get it.

I then asked for a small throttling governor, new or second hand, and 40 ft. of flexible wire cable; with these and some pulleys, etc., I made an automatic stop which is as good as the best.

From the throttle valve, a light cable runs up, across and down again to a weight about 12 ft. back of the crank shaft. From the crank shaft between belt wheel and outboard bearing runs a 1½-in. belt to a small throttling governor, set on a shelf about 10 ft. from the crank shaft, and 3 ft. from the floor. On this shelf support, which is a frame, a shaft made of ¾-in. pipe is run parallel with the crank shaft about 12 ft. from it, upon which are placed 2 pulleys and a crank. One of these pulleys is flanged with a hole bored through 1 flange, through which a sash cord is run and fastened there; the other end of the cord is attached to the weight at the eye with the cable. A piece of 1½-in. hoop iron is fastened with 1 wood screw to the top of the shelf on which the governor sits, and is then carried around the flat faced pulley and under the shelf to a pin about 1 in. past governor spindle.

This acts as a brake and when the weight is wound up and the hoop iron slipped on the pin, everything stays in position unless engine races. If the speed increases more than 4 revolutions the governor balls spread, the spindle lowers, and pushes the brake off the pin, releasing the weight which falls to the floor and closes the throttle valve.

This stop works fine, and has proved its usefulness many times during the past year or more. I would not again undertake to run an engine which is without other automatic stop, unless permitted to install such, the total cost need not be more than $10.



AUTOMATIC STOP FOR ENGINE

A slight pull on a wire attached to the break band will stop the engine from the engine room door 20 ft. away from throttle, this wire could easily be carried out in the mill if necessary. The nut on the spindle of throttle valve is removed and a flange pulley 3 in. in diameter and 2 in. between flanges screwed on, the same pattern was used for both flange pulleys, no machine work was done on any of the pulleys, except drilling, and tapping. Drilling was done with a small drill press in the boiler room.

This drill was broken in half at the time of the wreck; later I had the parts laid in the moulding sand at the nearby foundry and burned or melted together by which process a good repair can be made on any cast-iron column, brace, grate bar, etc. The way to do this is to lay the parts in the sand as though using them for patterns, and instead of removing them pour the melted iron over the broken part, allowing it to flow away until the ends are melting, then close up the outlet. W. C.

WISDOM is knowing what to do next; skill is knowing how to do it, and virtue is doing it.—David Starr Jordan.

POWERFUL HOSPITALITY

(Continued from page 741.)

Boiler Feed

FROM the heater a 4-in. pipe runs to the boiler feed pumps and a 3-in. pipe to the sump pit for emptying the heater when desired. The boiler feed pumps which take water from the heater and force it into the boilers are Knowles' 7½ and 5 by 6 in., duplex outside packed plunger type for 125 lb. pressure and with brass plungers and rods. By connections from these pumps water is carried through a 1½-in. pipe into the front heads of the boilers through 2¼-in. brass bushings placed 3¼ in. above the tubes, The feed pipe is screwed into the brass bushing from each side of the boiler head and goes back to within 2 ft. of the rear head and then across the boiler. The feed inlet to each boiler is provided with a 2-in. brass bodied gate valve, a 2-in. brass bodied extra heavy globe valve and a 2-in. brass bodied extra heavy check valve.

On the boiler feed line is installed a relief valve set at 175 lb. pressure with check and gate, and the discharge line from each pump is 3 in. in diameter, delivering into a 3-in riser which feeds the supply line to each boiler. A 3-in. Worthington plunger type hot water meter is installed on the 3-in. main line leading from the pumps, so that the water supplied to the boilers can be measured at all times.

As is the case in nearly all basement plants the floor level is below that of the sewer and it is, therefore, necessary that the drains be taken to a sump pit and from this the drainage is pumped to the sewer by means of a Yeoman's vertical motor-driven bilge pump.

Handling Coal and Ash

AS we turn to the boilers, we note the method of supplying coal and removing the ash. The system is so arranged that the only shoveling necessary is that to put the ash from the clean-out pits into the cans.

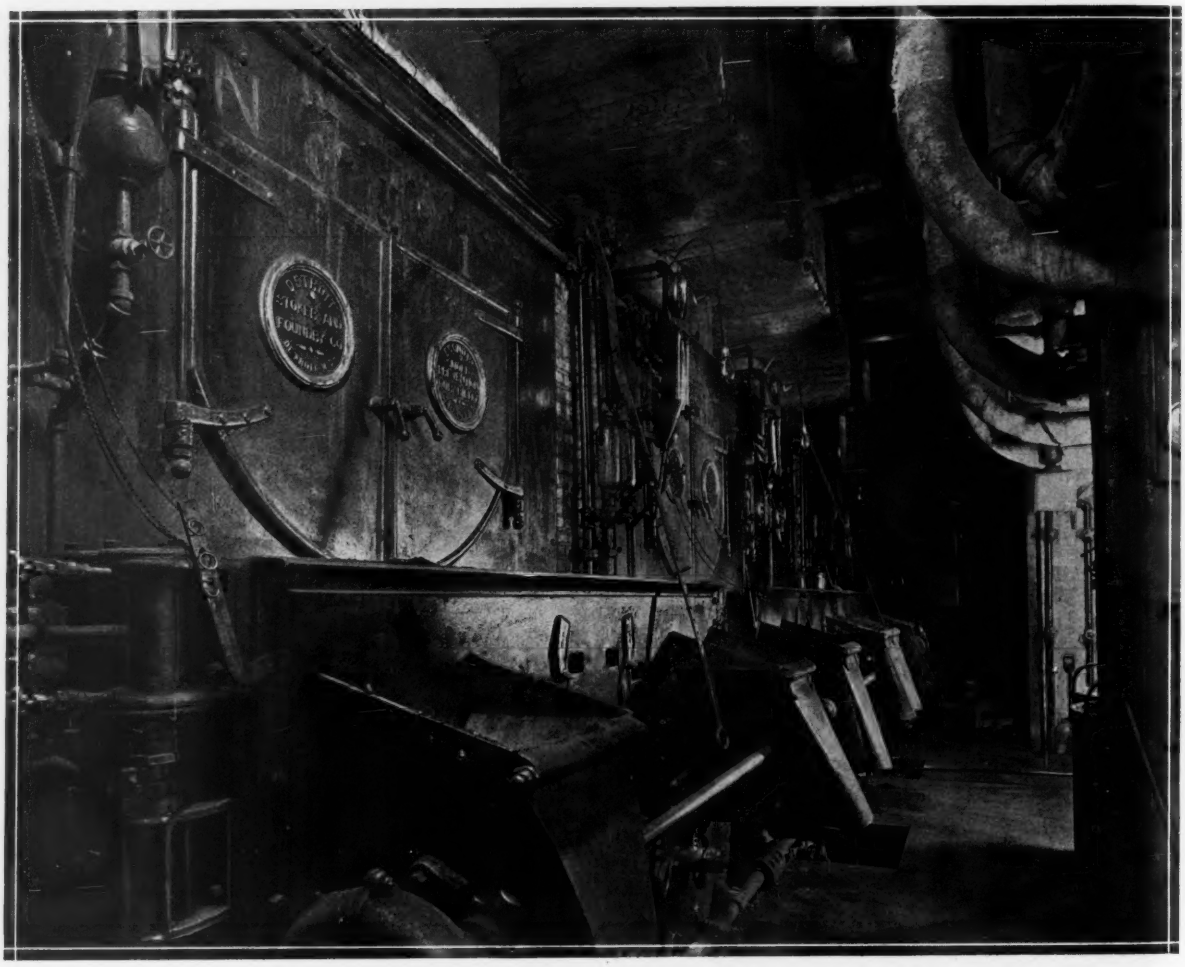


FIG. 11. BOILERS, STOKERS AND COAL HANDLING APPARATUS

Coal is stored beneath the pavement of the alley in bunkers having a capacity of 189 tons and from these bunkers it is dropped into a bucket through a hopper valve. This bucket rests on a narrow gage C. W. Hunt industrial railway car which runs from the passageway under the alley into the boiler room, where the bucket is taken by sling chains and a Yale & Towne Triplex chain hoist which runs on an I beam track in front of the boilers and over the stoker hoppers; the coal is dumped from the bucket into the hoppers by means of a door on the side.

Detroit stokers feed the coal under the boilers and the ash is dropped to pits beneath, from which it is

raked into the cleaning-out pits in front by hand and shoveled into cans provided with wheels, which are then run back into the passageway. Here a hydraulic rope hoist lifts them through a specially provided opening in the pavement to the alley where the ash is dumped from the cans into wagons to be carted away.

The ash lift for handling the buckets and the buckets themselves were furnished by the Minneapolis Steel & Machinery Co., buckets being 30 by 36 in., with steel bands top and bottom and a bail fastened below the center to allow of easy dumping. Twenty-four of these were included in the order.

The Steam Makers

COMING now to the boilers themselves, of which there are 4, each with a rated capacity of 150 hp., with shells 72 in. in diameter by 18 ft. long and with 70 4-in. tubes, the shell and heads are ½-in. plate of fire box steel having a tensile strength of 60,000 lb. and 50 per cent reduction at the fracture, with an elongation of 25 per cent in 8 in. The specifications called for a steel having not over 5 per cent sulphur and 4 per cent phosphorus and which would bend double, either cold or after being heated red hot and quenched, without fracture.

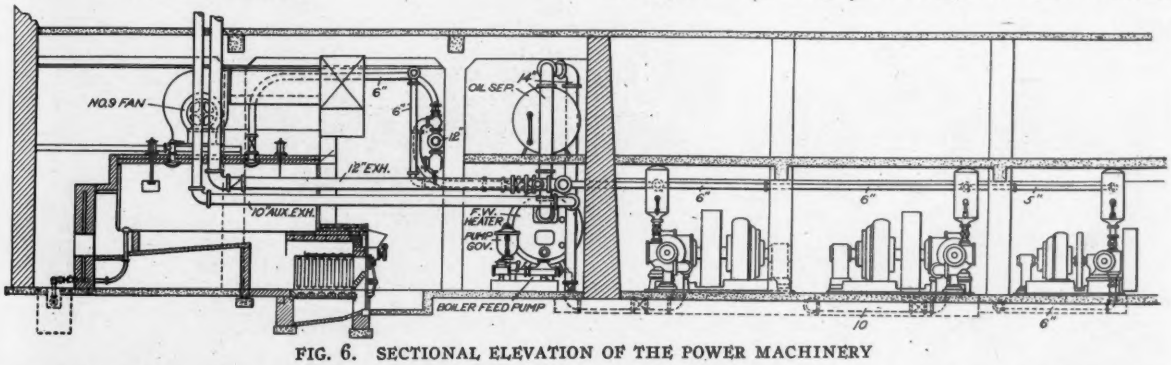


FIG. 6. SECTIONAL ELEVATION OF THE POWER MACHINERY

The boilers are made with girth seams, single riveted lap joint, having 15/16-in. holes, 2¼ in. pitch, punched and afterwards drilled and burr removed; the longitudinal seams are quadruple riveted with double covers over the butt joints and are arranged to have a 94 per cent efficiency. They are placed above the fire line and so as to break joints. The tubes are lap welded steel and are spaced 1 in. apart throughout, with a vertical space of 2 in. along the vertical axis. The holes were drilled, then chamfered on each side and the tubes expanded, rolled and beaded to make them secure and tight. The rivets are of soft steel having shearing strength of 42,000 lb. to the square inch and the stretch and percentage of elongation the same as for the shell.

For bracing the boiler diagonal braces are used, 3 ft. 6 in. long and having a section of 1 sq. in. at the weakest point. These are placed above the tubes, while below the tubes 4 head to head braces are used 1½ in. in diameter, fastened in approved form.

Manholes are provided, one in the front head below the tubes, 10 by 15 in., and one in the shell over the tubes, 11 by 15 in., each of these being reinforced with a wide plate.

Two extra heavy flanged nozzles are provided, one for the steam pipe and the other for the safety valve, the pipe being attached at the front nozzle, which is 6 in. in diameter, while the nozzle for the safety valve at the rear is 4 in. There is also a 4-in. flange attached for the blowoff at the bottom of the shell on the rear end.

The boilers were specified to stand 225 lb. hydraulic test and to be tight, and a certificate was required from the Hartford Boiler Inspection & Insurance Co., also an insurance of $400 on each boiler. The boilers are carried by suspending them from 2 pair of 10-in. 25-lb. I beams by U bolts to ears which are riveted to the boiler shell, steel pins passing through the ears and the U bolts. The I beam supports are connected by ¾-in. bolts and cast-iron separators, and are carried on 10-in. I columns at each end.

As fittings for each boiler, a 4-in. Crane safety valve is provided, also a Wright high and low alarm water column with 1¼-in. connections to the boiler and provided with Lunkenheimer extra heavy self-grinding try cocks having chain pulls for opening and with the drips carried to the ashpit. Compound feeders are also attached to the feed line, the compound being fed by gravity from a bottle-shaped steel chamber to the line at a rate regulated by the opening of a valve.

Blowoff valves are provided in duplicate, a Cadman 2½-in. extra heavy blowoff valve and a Homestead iron-bodied 2½-in. blowoff cock being put in series on each boiler. Both feed and blowoff pipes are extra heavy lap welded for high-pressure steam, having the fittings and flanges for 250 lb. pressure and the flange joints for the high-pressure service packed with corrugated copper gaskets and other joints packed with Rainbow packing.

A 1½-in. cold water line is carried to the blowoff connections with 1½-in. extra heavy gate valve and check valve to condense the steam. The blowoff line leads into a steel tank 3 ft. by 4 ft. with 3-in. vent to the roof; in this the water is cooled and from this it is carried to the catch basin.

Provision is made for expansion by means of long return bends in connections both from boiler to main header and from the header to the engines. The 6-in. lines from the boilers feed into a 10-in. header which is divided into 2 parts for convenience in making repairs or alterations, all valves on high-pressure steam mains being outside screw rising stem and all drip being drained off by Anderson and Dunham traps and carried to the Webster heater.

Foundations for the boilers are of concrete and the walls for the settings of hard burned brick 26 in. thick with 2-in. air space, carried the full length of the boiler. All surfaces exposed to the fire are lined with fire brick laid with 3 in. batter up to the point

where the setting closes against the shell, and with headers every 5th course. The ashpit is paved with hard burned brick and faced with Portland cement and the top of the boiler is covered with asbestos cement 1 in. thick on top of which is a rowlock course of brick faced with Portland cement.

For carrying away the smoke a breeching is provided of No. 10 steel, the draft ordinarily being furnished by the chimney but a fan is also provided for induced draft in case of overload, and by changing the dampers the gases may be sent through this. This fan, which is of the multivane type with 60-in. wheel running 240 r.p.m. is covered with Johns-

having a capacity of destroying 5 tons of garbage per 24 hr. The guarantee with the apparatus was that it should dispose of the refuse at a cost of 50c per ton with labor at 20c an hour and coal at $3 a ton.

It has a square steel fire box 4 ft. by 4 ft. and 6 ft. high from lower grate to crown sheet; the upper grate, on which the garbage is burned, consists of 1½-in. pipe extra heavy and secured into the crown sheet. The fire box is water jacketed with jacket built sufficiently strong to carry 100 lb. steam pressure, plates ⅜ in. thick with ¾-in. rivets, pitched 2½ in. and having stays 1 in. in diameter in the water leg, with screwed ends and riveted over. The coal is burned

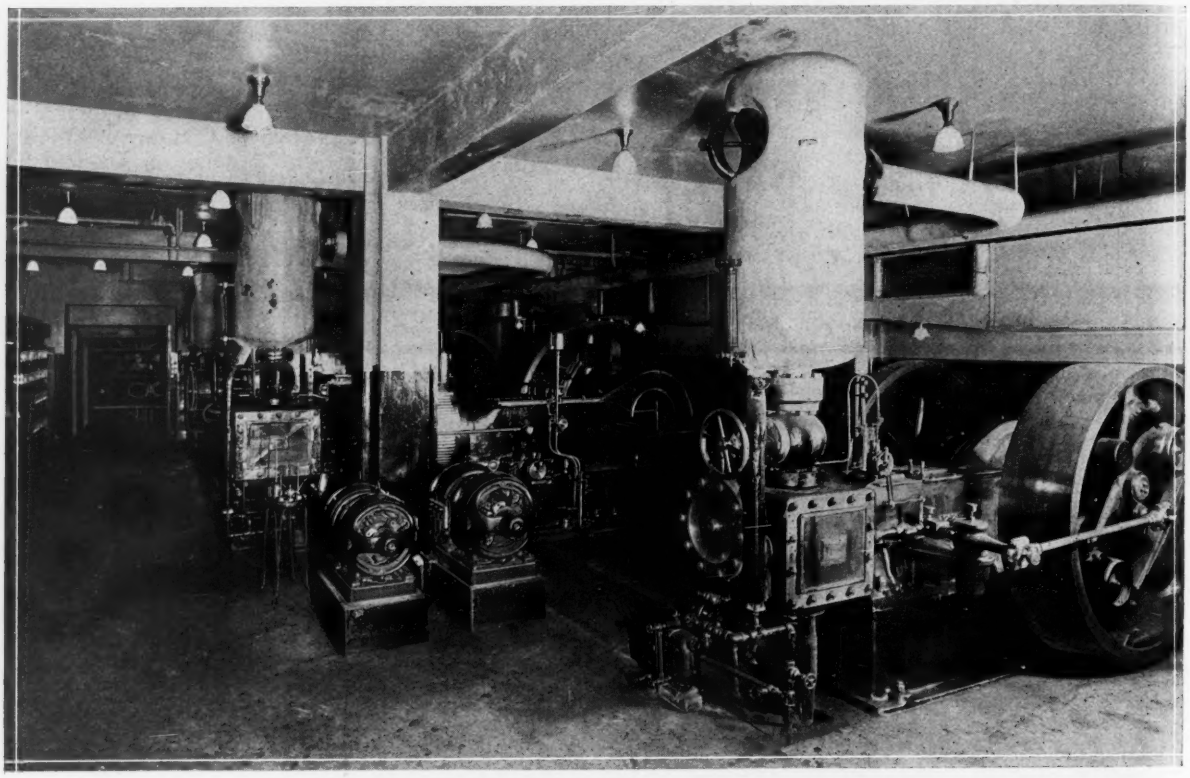


FIG. 10. LOOKING TOWARD THE BOILER ROOM

Manville Vitribestos insulation 1½ in. thick, and is located on top of the boilers.

At the rear of the boilers are located 2 No. 4 Tobey automatic water heaters and a hot water storage tank with reheater 60 in. in diameter by 14 ft. long, having a brass coil inside. The 2 heaters are cross connected to use either city water or water from the deep well, and the storage tank may be used on either system. A Worthington turbine pump is used for forcing the hot water through the piping system, this being motor-driven and having a hot water meter in its discharge line. For cleaning the boilers, Diamond Flue Blowers are installed, saving the expense and bother of steam hose and hand blowing. Also a Sargent draft gage tells the strength of the draft in the breeching.

Burning the Leftovers

AS we turn to leave the boiler room we face a novelty in power plant apparatus. This is the incinerator for the destruction of garbage, furnished by the DeCarie Incinerator Co., of Hopkins, Minn., and

on the lower grates, which are of cast iron shaking type.

Garbage is introduced at the top through a hopper opening 2 ft. 6 in. square, the hopper being made of ½-in. cast-iron plates. The breeching from this incinerator, which is 2 ft. 6 in. in diameter, of 3/16-in. tank steel and lined with 1½-in. asbestos, leads the gases and odors from the furnace to the main boiler breeching. On the steam jacket is a 1½-in. pop safety valve and the incinerator is provided with water column and an 8-in. steam gage, also with ½-in. gage cocks, water glass and blowoff valve. The shell was tested by hydraulic pressure with water at 60 deg. F. to a pressure of 150 lb. for 15 minutes without leak. The heated water from the incinerator is carried to the hot water system of the house or steam from it may be used for the exhaust heating system.

Generating Units

AND so we have found where Old Giant Steam lives and have seen much of what Old Giant Electricity does. Now we shall have a look at the workshop

where they combine forces and we find that the steam comes from the header in the boiler room through reverse return bends, which take steam out of the top of the header to avoid carrying condensation, then swing backwards toward the boilers, downward and out into the generator room and then with a long sweep around to the separators where the last moisture is taken from the steam by Cochrane receiver type steel plate separators, with manholes for inspection and any necessary cleaning, then downward to the engines, of which there are 3 in the plant.

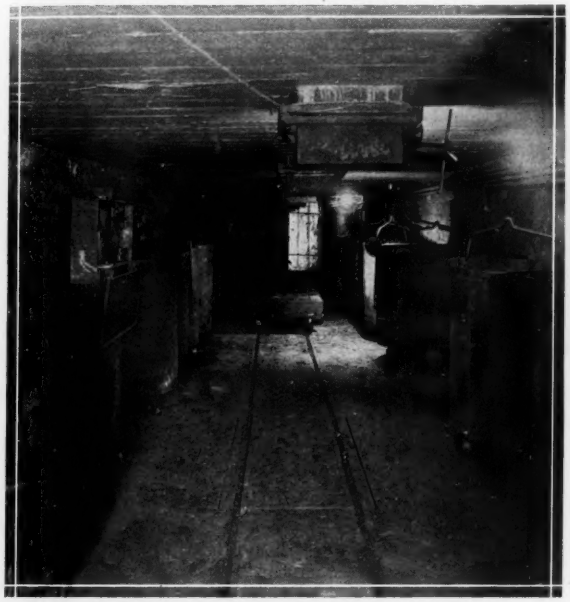


FIG. 12. UNDER THE COAL BUNKERS, ASH CANS AND SCALES

Two of these are tandem compounds taking steam from the boilers at 140 lb., carrying it to a receiver at a pressure of 40 lb. and then exhausting at a back pressure of 3 lb. into the main, which goes first to the Baldwin steel plate oil separator and then on either by the outdoor exhaust to Swartwout exhaust heads on the roof or to the heating system of the hotel. Each of these engines is connected to a 200-kw. generator, one of the engines being 15 and 26 by 20 in., the other 16 and 27 by 20 in., both running at 200 r.p.m. They were furnished by the Skinner Engine Co., of Erie, Pa., and were chosen because of high guarantee of regulation and low steam consumption.

The 3rd unit is a simple engine 14 by 16 in., driving a 100-kw. generator at 260 r.p.m. The simple type being used because during light load periods more steam is needed about the building than the engine exhausts. All these generate current at 220 volts and feed it into busbars on the switchboard which supply lighting or power, or both. The lights are run on the 110-volt 3-wire system, the neutral wire current being taken care of by a balancer set, while all motors are run at 220 volts. This gives longer life for Tungsten lamps on the 110 volts than would be possible at 220, at the same time makes possible smaller transmission wires and lower cost and higher speed motors, which work better under variable load such as elevators.

The generators were furnished by the Electric Machinery Co., of Minneapolis.

Lubrication of the cylinders is by means of Rochester automatic force feed lubricators made by Greene, Tweed & Co., and of the bearings by the flooding system of the Skinner Engine Co., the oil being fed to the bearings by gravity and returned from them to the tank by means of a pump after passing through a filter.

Near the smaller unit are 2 balancer sets, 1 of 9 and the other of 6 kilowatts capacity, running at 850 and 900 revolutions respectively and furnishing current at 115 volts to either side of the 3-wire system, as the load may require. This is connected with the fields of both machines excited from the 220-volt buses, while the armature of one machine is on one side of the neutral and the other armature on the other

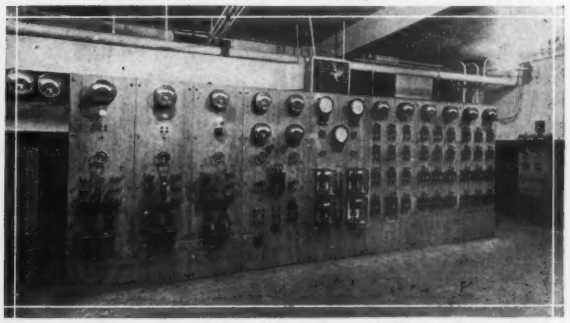


FIG. 13. THE SWITCHBOARD FOR CONTROL AND DISTRIBUTION OF POWER

side. In this way the armature on the light side of the system acts as a motor to draw current from that side and drives the armature on the heavy side of the system as a dynamo to furnish current for its side.

Signal Current Service

TO furnish current for the signal systems a pair of small motor generator sets are provided, the motor driving from the 220-volt mains and the armature furnishing current at 22 volts for the maids' and waiters' signal systems, fire alarm service and the master clock system.

All clocks in the hotel are driven by magnetic action from an extremely accurate master clock, which is located in the engine room, and by closing a magnetic circuit at the end of each minute energizes magnets in the clocks all over the building, thus setting them ahead by one minute jumps.

That the engineer may know how the plant is operating, a handsome gage board made by the American Steam Gauge and Valve Mfg. Co. is installed between the 2 larger units, and equipped with gages showing the boiler pressure, 140 lb., receiver pressure, 40 lb., the back pressure, 3 lb., pressure in the water mains, 60 lb., pressure from the overhead tanks, 85 lb., and the vacuum maintained by the Paul ejectors. All gages are 12 in. in diameter, as is also the clock which is mounted on the board.

Steam piping around the plant is all covered with 85 per cent magnesia covering furnished by Keasbey & Mattison, the thickness varying from 7/8 in. to 1¼ in., according to the size of the pipe; while the cold water pipes are covered with Johns-Manville Antisweat covering and the fittings with Plastic Mag-

nesia cement finished with a canvas jacket and held in place by brass bands at the joints.

The Switchboard

THERE has to be some way to keep tab on this generating outfit and also to control it, and for this a switchboard built in place by W. I. Gray & Co., of Minneapolis, is installed, having 8 panels. Three of these at the left-hand end control the 3 generators, the next to the right is a balancer panel, next to that a totalizing panel, then one for the control of the power circuits and 2 for the control of the lighting circuits. At the extreme left-hand end are mounted 2 voltmeters on a swinging arm, one of these being always on the busbars and the other connected as may be desired, across the 220-volt terminals of any generator or across either side of the 3-wire system.

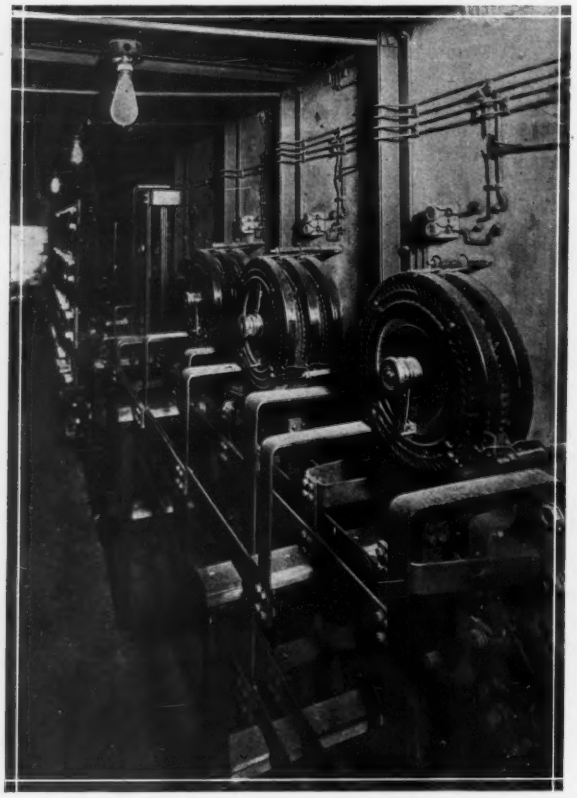


FIG. 14. REAR VIEW OF SWITCHBOARD

For the control of the generators, an ammeter is mounted on each generator panel, also a 2-way 3-pole switch, the object of this being so that any generator may be thrown on either the light or the power buses which run across all generator panels. On the totalizing panel there is also a 2-pole switch which can be used for throwing the power and lighting buses together if desired. I. T. E. circuit breakers, Cutler-Hammer rheostats, voltmeter switch receptacles, and tell-tale lamps are also found on the generator panels.

The switchboard is of gray Vermont marble with beveled edges to the panels, mounted on a 6-in. channel iron base set in 6 in. of concrete, and supported by an angle iron frame. Busbars and connections are proportioned on the basis of 800 amperes per square inch of cross section and 50 amperes per square inch of contact. The panels are 2 in., and the subpanels 2½ in. thick, 18 in. high and of the same width as the panels.

On the balancer panel are switches for each set. These close the field first, then the armature and then the connections to the neutral wire, also there are ammeters and voltmeters to show under what conditions each side of the balancer set is operating. Each balancer has, of course, its own outfit of switches and instruments, although the balancers can be run in parallel if necessary.

Wire connection from the 200-kw. generators to the switchboard is by means of 6 800,000 circular mil stranded cables laid in 2 4-in. conduits, and a No. 2 wire for the field circuit, while for the 100-kw. unit there are 6 300,000 circular mil cables in 3-in. conduit and a No. 6 wire for the field. Connection from the switches to the busbars is made by means of copper studs bolted through the flat strips and the copper busbars are supported by bolting to the slate and to the angle iron frame, insulation being, of course, introduced between the bars and the angle iron.

The totalizing panel is fitted with Bristol recording ammeters for power and lights, a voltmeter which can be used to measure either 220 or 110 volts, a voltmeter switch for various connections and with Duncan wattmeters to measure the current supplied for lighting in both club and hotel, and also for power in the 2 establishments. There is a 2-way switch for the kitchen fan and refrigeration motors, and ammeters and switches are provided on the distributing panels for keeping track of the load which goes to different departments.

For the control of the small motor generator sets and signal systems, a baby switchboard is provided at the right of the main switchboard and facing at right angles to it, the necessary outfit being supplied for the complete control of the sets and the systems; and in the center of it all, where he may watch all that goes on and hear the least hint of irregular action, is the desk of the chief engineer, J. Stophilbeen, who, with his assistants, is charged with keeping in continuous operation the plant which means so much to the comfort and well-being of those who are entertained at Hotel Radisson. The numerous calls on his time and attention from the many systems installed are evident and the fact that the plant runs smoothly and that there has been no breakdown or inconvenience of guests from the time that the hotel was opened bears evidence of the excellence of the outfit as well as to the watchfulness of those in charge.

And credit must also be given to the man whose brain planned the arrangement and wisely chose the types and sizes of machinery needed to compose the plant. To Chas. L. Pillsbury, of Minneapolis, is due this credit, and the great number of plants which he has installed in and around Minneapolis is evidence as to the satisfactory results which he produces.

We have discovered all that there is to discover as to the secrets of how they do it. There is left but to enjoy the results of all this and to express our appreciation to those in charge of the plant and of the hotel for their courtesy and for the comforts which they provide, and as we go on our way we are ushered out by the same Old Giant Electricity who busily buzzes away in an electric motor which turns the revolving outer door to welcome the coming as well as speed the parting guest.

PRACTICE PROBLEMS

BOILER ROOM AND ELECTRICAL FIGURING

IN THE boiler practice problems from November the heating surface is to be figured. It is 2/3 the shell surface, which is 60 in. diam. by 16 ft. long, plus the outer surface of 44 4-in. tubes 16 ft. long, plus the area of the back head 60 in. diam. minus the area of the 44 tube ends.

For the shell, 5 ft. diam. the circumference is found with j set; above 5 on B is 15.75 on A. Two-thirds of this times 16 gives 15.75×2÷3×16; and set 1 on C to 1575 on D; set runner to 2; bring 3 on slide to runner; bring runner to 16 on C and below it find 168.3 sq. ft.

For a tube, setting slide at j, the circumference on A, above 4 on B is 12.6 in. and dividing this by 12 gives 1.053 ft. This times 16=16.85 sq. ft. for each tube and 44 times this=738 sq. ft.

For the back head, setting slide at G, above 5 on C find 19.5 sq. ft. on A. From this is to be subtracted 44 tube ends, and with the same G setting, the runner at 0.333 or 1/3 ft. on C shows 0.1113 sq. ft. per tube, or for 44 it is 44×0.1113=4.88 sq. ft. Then 19.5—4.88 =14.62 sq. ft. in the back head; and adding shell, tubes and head, 168.3+738+14.6=92.09 sq. ft.

At 12 sq. ft. per horsepower, we have, above 921 on D set 12 on C and under 1 on C find on D, 77, the required horsepower.

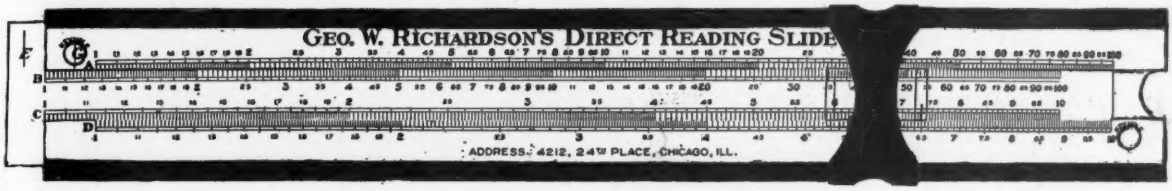


FIG. 1. SETTING AT G TO READ CIRCLE AREAS

2. To find the actual horsepower of the boiler evaporating water from 196 deg. and at 130 lb. it is necessary to find the total heat for 130 lb. gage pressure from steam tables, which give 1192.8 B.t.u.; from this subtract the heat of the liquid at 196 deg. or 196—32=164, and 1192.8—164=1028.8 B.t.u. Dividing by 966 we get 1028.8÷966; set runner to 1029 on D and bring 966 on C to the runner; below 10 on C will be 1.0623, the factor of evaporation.

Divide the total evaporation, 12,200 by the time, 5 hr. and the evaporation per hour is 2440 lb. per hr. This times 1.0623 gives 2585 lb., the equivalent evaporation from and at 212 deg. per hour. Dividing by 34.5, the evaporation to give 1 hp., we have 2585÷34.5=75 hp. As to the percentage of rated power, the answer to the first problem was 77 horsepower, hence 75÷77=0.976 or 97.6 per cent.

3. For a round chimney 52 in. diameter, with slide setting G, over 52 on C is found 2100 sq. in. on A. To get the side of a square having this area, extract its square root, and under 2100 on A will be found on D 45.8 in., the side of the square flue to equal the round chimney in area.

Coal Bunker Capacity

AMONG the reports frequently made out by engineers are monthly reports of coal and oil on hand. The coal bin is usually part full and the coal lies on a slope. Of course, the average height in the center is taken and the cubic feet computed. We then have to change the cubic feet of coal to the pounds or ton. In heaps or bins the weights are as follows:

For anthracite 38.4 cu. ft. per ton, for bituminous 45.3, so that we can figure on this basis. If, for instance, the bin is 18 ft. wide and the coal extends from the end 21 ft. on the floor and at the back or highest point has a height of 7 ft., the average height will be 3.5 ft., assuming a uniform slope. The cubic feet would then be 18x21x3.5.

Set 1 on C to 18 on D, bring the runner to 21 on C, then 10 on C to the runner and the runner to 3.5 on C. Beneath this on D is found 1338 cu. ft. If the coal be anthracite, this is to be divided by 38.4. Bring 384 on C to the runner and under 10 on C will be found 34.4 tons. If the coal be bituminous we should divide by 45.3, that is, bring 453 on C to the runner and beneath 10 we find 29.1 tons.

FIG. 2. SETTING AT C TO CONVERT GALLONS TO POUNDS

In case the coal is piled in a heap so that it takes practically the form of a cone, measure the diameter of the base as closely as possible and the height from the base to the apex. The cubic contents is then 0.2618 times the diameter squared, times the height. In the case of a cone having a diameter of 23 ft. and a height of 12 ft., we should have $0.2618 \times 23^2 \times 12$. As we have a squared number we must work with the A and B scales. Set 1 on B to 262 on A. Bring the runner to 23 on C. Bring 1 on B to the runner, bring the runner to 12 on B, and over this on A will be found 1660 cu. ft.

As there may be some confusion in regard to the position of the decimal point in such problems it may be well to repeat that the easiest method of finding

this is by inspection of the problem. In the multiplication above we can quickly test for position of the decimal point by taking the nearest even numbers. We should have $0.25 \times 20^2 \times 10$. 20^2 will be 400, times 10 is 4000, and 1/4 of this is 1000, showing that the result must have 4 places to the left of the decimal point.

This number of cubic feet must, as before, be divided by the cubic feet per ton, and assuming that it is bituminous coal we bring 45.3 on B to the runner, and over 1 on B we find 36.6 tons on A.

Water Meter Readings and Repeated Multiplication

WHERE records are kept of water and coal consumption readings are often taken by means of water meters and these are graduated to read in gallons or cubic feet. In making up the power plant report these values must be changed to pounds and it becomes necessary to change a series of the water meter readings in this way to get daily performances of the plant as to evaporation of water per pound of coal used. Take the case of a plant where the readings for 6 days were as follows:

METER AND COAL READINGS AND COMPUTED RESULTS

	WATER				
	METER READING	GALLONS USED	EQUIV. POUNDS	COAL USED LB.	EVAPORATION PER LB. COAL
NOV. 28	56,985	7336	61,200	9876	6.20
NOV. 29	64,321	7242	60,350	9638	6.25
NOV. 30	71,563	7232	60,300	9634	6.27
DEC. 1	78,795	7341	61,300	9905	6.20
DEC. 2	86,136	7542	62,800	10124	6.20
DEC. 3	93,678	6231	51,950	8729	5.95
DEC. 3NT.	99,909				

The reading is supposed to be taken in the morning of each day before starting up, so that the difference between 2 successive daily readings gives us the amount of water evaporated in 24 hr., the meter being on the line leading to the boilers, and the coal weight is the amount used in 24 hr. Taking the differences in meter readings, we have, for Nov. 28, the amount used shown by the second column, and it is necessary to convert this into pounds. The weight of a United States gallon is 8.33 lb. and for this conversion we use the setting c in the lower keyhole. Then for any given number of gallons on D, the weight of the water is found on C, that is, in each case we have to multiply the number of gallons of water by 8.33 so that by placing c in the keyhole we set 10 on D to 833 on C, and then above any figure on D, we find the product of that figure and 833 on C. In the present instance we set the runner to 7336 on D for Nov. 28, and on C we read 61,200; Nov. 29 the runner to 7242 and on C read 60,350; Nov. 30 the runner to 7232 and on C read 60,300; Dec. 1 runner to 7341 and on C read 61,300; Dec. 2 the runner to 7542 and on C read 62,800; Dec. 3 the runner to 6231 and on C read 51,950.

Then to determine the daily evaporation per pound of coal we have to divide the weight of water by the weight of the coal. For Nov. 28 set the runner to 612 on D, bring 9876 on C to the runner; under 10 on C will be found 6.2. For Nov. 29 set the runner to 6035 on D and bring 9638 on C to the runner; under 10 on C is found 6.25 on D. Nov. 30 likewise gives 6.27 lb. evaporation; Dec. 1, 6.2; Dec. 2, 6.2; Dec. 3, 5.95.

Electrical Computations

TAKING now the problems given in the article on Electrical Computations in this issue. To find the ratio of the load which the smaller of the 2 dynamos first mentioned is carrying to its capacity, we have $320 \times 118 \div 50{,}000$. On the rule we set the runner at 320 on D, bring 5 on C to the runner, carry the runner to 10 on C and shift the slide to the right hand position, then carry the runner to 118 on C and beneath this on D is found 0.756. A similar computation would give the percentage for the larger machine.

For the efficiency of the larger generating unit we have $67{,}968 \div 746$ and divided by 108.5. We set the runner at 679 on D. Bring 746 on C to the runner, carry the runner to 10 on C, bring 1085 on C to the runner, and under 1 on C we find 0.84.

For computing the resistance of the main wire circuit, we have $55 \times 40 \div 110$, and 8 is to be divided by the quotient. We are then to divide the quotient of this by 300 and multiply by 1000. If we write down these various operations in continued form it gives us the following expression:

$$8 \div (55 \times 40 \div 110) \div 300 \times 1000$$

To perform these operations, we set the runner at 8 on D, bring 55 on C to the runner, bring the runner to 110 on C (because the double division is the same as a multiplication), bring 40 on C to the runner, bring the runner to 10 on C, bring 3 on C to the runner, and under 1 on C we find 1.335 ohms as the required resistance.

In like manner the other computations worked out in the electrical article may be carried through by the use of the slide rule and it will be seen that by writing down all the computations that are to be carried through before doing any of them, a very considerable saving in work can be effected. That is one of the advantages of the use of the rule. The intermediate operations may all be carried along without recording the result until we get to the end, or we may take off the result of any operation at any point and make a record of it.

DANGER FROM HIGH PRESSURE

IT IS related that when Massachusetts license law went into effect there was among the applicants for a fireman's license an old man who for years had been employed in one of the suburbs of Boston cooking garbage which was used for feeding hogs. Replying to the varied questions of the examiner he gave a description of the plant method of feeding by city water pressure, etc.

On being asked what steam pressure was carried he said with a rich brogue, "Tin pounds, Sorr." "Now," said the examiner, "you carry 10-lb. pressure to do your work. Suppose that while you were busy and not noticing what was going on the steam pressure should run up to 50-lb., what would you do?"

With eyes of astonishment at the display on the part of the examiner of such abysmal depths of ignorance of the art of swill boiling, and trembling with indignation at the thought that such carelessness could be even mentioned in connection with him he hastily and hotly said:

"Oh, Sorr! The likes of ye shud know that it wud never do at all; it wud blow the schwill all to hell."—Publicity Magazine.

WATERPROOF GLUE

TWO good recipes are as follows: To 0.5 pint best Scotch glue add 1 oz. bichromate of potash. The glue cannot be remelted after cooling.

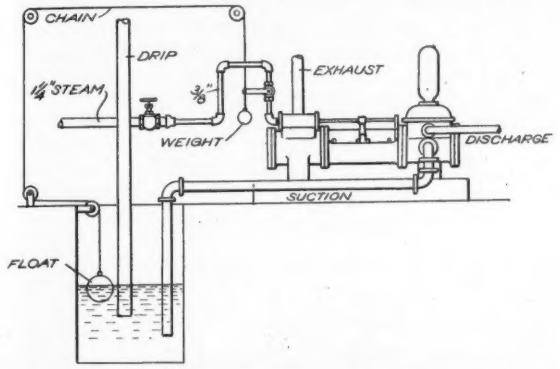
Melt and mix together 1 part beeswax and 2 parts rosin. Stir into this hot whiting rubbed fine until a stiff mixture is obtained. This is made into sticks and used like sealing wax.

Questions and Answers

To help you when in trouble; give name and address. If quick answer is wanted, enclose a stamp for reply.

Difficulty with Regulator

CONSIDERABLE trouble has been experienced with the regulator system shown in the illustration and I would like suggestions from readers of Practical Engineer as to a better method for regulating the pump, which was made by the Knowles Steam Pump Works. Frederick Peacor.



PUMP REGULATOR ARRANGEMENT WHICH GIVES TROUBLE

Wanted—A Signal System

AT our power station there is but one man on duty at a time, there being 2 shifts of 12 hr. each, and we have had occasion where night men went to sleep on duty. A watchman's clock would meet this condition but we wish to protect both the man and ourselves against the man being disabled and not able to phone or turn in an alarm. Several hours might elapse before conditions became known possibly losing the man his life and ruining the plant.

Required, therefore, an automatic system registering in half-hour or one hour periods which would give an alarm either by whistle at the plant or bell at a distant point should the attendant not be present at the device at the predetermined time to prevent its alarm. Also, as the man has other duties, it might be impossible for him to be there just on the minute and such device should give him at least 5 min. warning. It should also be of such construction that he could not tamper with it to prevent its action for any number of periods in advance allowing him to cut it out entirely for several hours. It should thus answer the purpose both of a watchman's time detector and a safety device.

Scoring of Cylinder

WHY will a cylinder on a common slide valve engine cut full length on the side next to ports and the remainder of the cylinder be bright and smooth? The rings were bright and smooth and the follow head had no marks from wearing or touching the cylinder. The engine runs 132 r.p.m. and I average 2.5 lubricators of oil, 1 pt. each. L. W. D.

Alining an Engine; Paint for Cement

IS there any way of testing the alinement of an engine without stripping the engine and running a line through the cylinder? Can it be done by stretching a line along the side? Please give information with sketches showing how the method applies to either Corliss or high speed center connected type.

2. Can anyone give a receipt for a durable paint mixture for cement floors? C. D.

Practical Boiler Questions

WHAT are the 3 chief requirements necessary to obtain the best results in the operation of boilers?

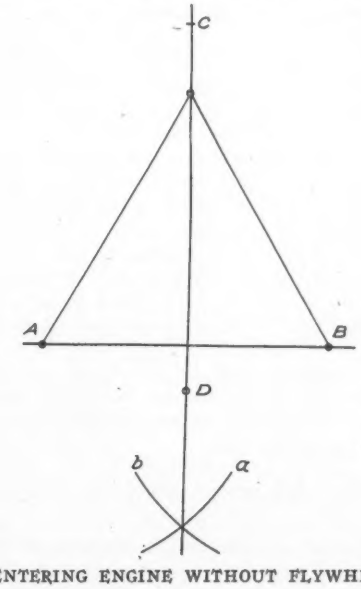
2. Of what use is a drop arch in a furnace?

3. If you were called on to take charge of a plant, what would be your first duty? L. A. D.

Putting Engine on Dead Center

HOW do you find the dead center of an engine that has neither crank disk nor flywheel, such as the Lima locomotive? W. C.

A. The same principle applies to finding the dead center of your locomotive that would apply in the case of an engine having a flywheel or crank disk. We have to find 2 shaft positions, one with the crank one side of the center line, the other with the crank the other side, in which the crosshead and piston rod are in the same position, and then turn the shaft by half



CENTERING ENGINE WITHOUT FLYWHEEL

the angle between these 2 positions. You can make marks on the shaft of the engine the same as you would on the rim of the flywheel, but this involves some inaccuracy, because the distance between these marks will be so small. You can make successive marks on the piston rod where it slides into the stuffingbox and note when this is at its extreme position inside the box and starts back. There will, however, be a slight uncertainty in this because the motion of the piston rod is very slight for quite a little time when the crank is swinging past center.

The best way is as indicated on the sketch herewith, which you will have to adapt to the details of your particular locomotive. Set the crank at some distance to one side of the center and mark a line on crosshead and guide. With a double-pointed tram put one end into the center of the crankpin and with the other end swing an arc to strike on some part of the frame so that it will cross the center line, as shown at a. Swing the engine past center until the crosshead mark comes to the same position on the guide and the crankpin is at B. Then with the same tram as before, strike an arc b intersecting the first arc. The intersection of these 2 arcs will be on the center line. Swing the crankpin so that its center lies on a line from the center of the crosshead pin through this point of intersection, as at D, and the crank will be set on dead center.

By studying the engine design you will be able to see about where on the frame the 2 arcs can be struck and a tram can be made of the proper length. This tram may, of course, be simply a hardwood stick with 2 nails driven through it, or any other method by which 2 points can be kept at a fixed distance.

Connecting Boilers

TWO water-tube boilers are to be connected to the same steam main which is 5 in. in diameter, supplying engines of about 400 hp. One, a Stirling, has been in operation several years; the other, a Franklin, is to be installed.

Are there any precautions to be observed in the piping owing to their inequality in height? Is not a riser to the level of the pipe already connected to the Stirling boiler all that is required? L. E.

A. The only precautions needed in connecting the 2 boilers are that there shall be no possible loop in which water can collect. A straight riser from the Franklin boiler to the pipe already connected to the Stirling will be sufficient, being careful that this riser is so arranged that the water will be forced to run back into the boiler. A long piece of horizontal pipe with only a slight pitch will not answer this purpose, but a long bend with a straight drop into the steam space of the boiler will be all right. As the water level in the 2 boilers will not be at the same height there should, of course, be no connection between the water space in the two.

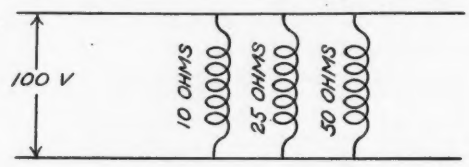
Boiler Efficiency; Electrical Problem

AN analysis of coal in a boiler test was as follows: 80 per cent carbon, 5 per cent hydrogen, 4 per cent oxygen, 2 per cent nitrogen and 9 per cent ash. The amount of coal burned in the trial was 4000 lb., 25,000 lb. of feed water was evaporated from a temperature of 100 deg. F. into steam at 100 lb. absolute. What would be the efficiency of the boiler?

2. A group of 3 circuits in multiple is connected across between the line wires of a 100-volt circuit. The first circuit has a resistance of 10 ohms, the second a resistance of 25 ohms, the third a resistance of 50 ohms. What is the joint resistance of the 3 paths in multiple? What is the current in each circuit? What is the rate in watts at which work is being done in each of the circuits? Roy Stahl.

A. For computing the heat value per pound of coal, the ordinary expression is 14,650 times the per cent of carbon, plus 62,100 times the per cent of hydrogen, minus 5400 times the per cent of nitrogen. This gives the B.t.u. per pound of combustible, and to get the combustible we multiply the total coal by 100 minus the percentage of ash. Working it out for your problem, we have: $14,650\times0.8+62,100\times0.05-5400\times0.02$, and performing these operations gives 14,477 B.t.u. per pound of coal. 100—9 gives 91, the per cent of combusible, and multiplying by 4000 gives 3640 lb. of combustible, which multiplied by 14,477 gives 52,096,280 as the total heat supplied.

At 100 lb. absolute the total heat of steam is 1191.8



RESISTANCES IN PARALLEL

B.t.u., as given in the steam tables, and at 100 deg. F. the heat in the liquid will be 100—32=68 B.t.u. Subtracting this from 1191.8 gives 1113.9 B.t.u., the amount supplied to each pound of water, and multiplying this by 25,000 gives 27,847,500 B.t.u. taken up by the water. Dividing this by the heat supplied gives 0.5285 or an efficiency of 52.85 per cent.

2. The 3 circuits connected in multiple between line wires would be arranged as shown on the sketch herewith.

To find the combined resistance we first divide 1 by the resistance of each circuit and add the equations. We have then $1/10+1/25+1/50$, which added together gives 8/50. Taking the reciprocal of this, we have 50/8, or 6.25, as the combined resistance of the circuits. The current in each circuit will be found by dividing the total voltage by the resistance of that circuit. For the first it will be $100\div10=10$, for the second $100\div25=4$, and for the third $100\div50=2$.

The watts in each circuit will be found by multiplying the current by the voltage. For the first one it will be $10\times100=1000$, for the second $4\times100=400$, and for the third $2\times100=200$ watts.

Properties of Steam

IF the steam in a boiler is 270 deg. and feed water is 100 deg., how many units of heat will it take to turn a pound of it into steam?

2. How would you determine the proportion in area of the cylinders and the point of cutoff in each cylinder in a compound engine of 2 cylinders, the initial pressure is 100 lb. above the atmosphere and your final pressure 10 lb. below atmosphere?

3. Steam is 1640 times the volume of water, what weight of steam would be used per hour with a pair of engines 30 in. in diameter, 5-ft. stroke, making 30 r.p.m., discharging steam at atmospheric pressure?

4. What is the specific gravity of steam?

T. C. W.

A. From the steam tables we find that steam at 270 deg. F. contains 1164.1 heat units above 32 deg.

F., the heat units contained in 1 lb. of water at 100 deg. F. is 68.08. The difference, or 1096.02 heat units, will be required per pound of water at 100 deg. to turn it into steam at 270 deg.

2. There is considerable difference of opinion among engineers as to the proper ratio between the areas of the high-pressure and low-pressure cylinders of a compound engine. Busley makes the ratio dependent upon the boiler pressure, thus:

Lb. per sq. in ...	60	90	105	120
V÷v	3	4	4.5	5

where V=the volume of the low-pressure cylinder, v=volume of the high-pressure cylinder. Since the length of stroke in the 2 cylinders is the same, the volumes will be proportional to their areas, or to the squares of their diameters. In other words, where the steam pressure is 105 lb., the ratio of the diameters will be as 1 is to the square root of 4.5, or the diameter of the low-pressure cylinder would be 2.12 times that of the high-pressure cylinder. It is general custom to have the cutoff in the high-pressure regulated by the governor, this varies from ¼ to ½, as the load on the engine varies. The cutoff in the low-pressure cylinder is regulated by hand to obtain a nearly equal load on each cylinder.

3. The weight of steam used by an engine depends upon the point of cutoff, and assuming this to be at 1/3 stroke we would have the volume of steam used per stroke equal to $0.7854\times2.5\times2.5\times\frac{5}{3}=8.18$ cu. ft. for an engine which has a cylinder diameter of 30 in. and stroke of 5 ft. From the steam tables we find the weight of steam per cubic foot at 100 lb. gage pressure to be 0.2617 lb. Multiplying this by the volume used per stroke, times the strokes per minute, times the minutes per hour, gives

$0.2617\times8.18\times30\times2\times60=7700$ lb. of steam used per hour by one engine. Two engines would require twice this amount, or 15,400 lb.

You state in your question that the volume of steam is 1640 times the volume of the water required to make this steam. This ratio holds good only when the pressure is that of the atmosphere, consequently could not be used in the calculation of the problem which you have presented.

4. The specific gravity of steam, you will note by reference to steam tables, varies with the pressure under which it is generated. At atmospheric pressure it is $1\div1646=0.000608$. At 100 lb. gage pressure it is $1\div237.6=0.00422$.

Examination from the Transvaal, South Africa*

A NEW multitubular, externally fired boiler is installed in a plant. Its shell is 6 ft. diameter by ⅝ in. thick (the shell is presumed to be the weakest part of the boiler). The tensile strength of the boiler plate is taken at 65,000 lb. per sq. in. The efficiency of the joints is taken at 70 per cent of the plates; what is the safe working pressure of the boiler, if the factor of safety is taken at 5? (Work this out by Board of Trade Boiler shell formula.)

2. The boiler referred to above has 1100 sq. ft. total heating surface and each square foot under the assumed conditions transfers to the boiler contents an average of 60 B.t.u. per minute. The boiler is fed with water at a temperature of 202 deg. The steam at the boiler stop valve is assumed to contain 3 per cent of its weight of water in suspense. What will be the weight of the wet steam (steam and water in suspense in it) supplied by the boiler per hour?

3. The grate area of the boiler in questions 1 and 2 is 35 sq. ft. The fuel fired has a calorific value of 10,500 B.t.u.'s per lb. The total losses (through unburnt fuel discharged with ashes, incomplete combustion, radiation, heat in waste gases, etc.) are 28 per cent, of the total heat value of the fuel. How much fuel must be fired per square foot of grate per hour to obtain the above output of boiler?

4. Describe any well known design of Corliss valve gear. Detail your ideas of the advantages and disadvantages of the gear you describe.

5. Sketch 3 indicator cards showing (a) excessive lead on steam valve, (b) late admission, (c) late exhaust.

6. A compound condensing engine, installed at sea level is supplied with steam at 140 lb. initial gage pressure at the high-pressure cylinder. The initial pressure in the low-pressure cylinder is 3.22 lb. below the high-pressure cylinder terminal pressure. A vacuum of 17.7 in. is maintained at the low-pressure exhaust. The effective piston areas are 150 sq. in. and 600 sq. in.; the stroke is 42 in. The engine runs at 75 r.p.m. The cutoff is 25 per cent. What is the approximate indicated horsepower? (Note: The effect of cylinder clearance may be neglected.)

7. In ordering plates for boiler shells, what tensile strength would you specify?

8. What mean elongation should there be in a 10-in. test piece of boiler plate?

9. What is the maximum working stress per square inch of section you would allow for solid steel screwed boiler stays?

10. What factor of safety should boiler stays have?

11. What would be the breaking load of an ordinary short link chain 1 in. in diameter?

*All questions are supposed to be answered in accordance with board of trade rules.

ANSWERS TO EXAMINATION

MASSACHUSETTS THIRD CLASS LICENSE

By Paul E. Capraro

IN setting the valves of a slide valve engine the first step is to put the crank on one of the dead centers. For convenience, we will take the inner or head-end center first. This can be done in a number of different ways, but the best and most accurate way is to bring the crank a little above the inner dead center and make a mark on the crosshead and one on the guide in line with it. Then take a tram of about the same length as the distance from center of shaft to the floor and make a mark on the flywheel rim a distance of this length from the floor. Now move the flywheel so the crank will be below the dead center a distance as great as it was at first above the dead center. This will be the case when the marks made on crosshead and guide are again in line with one another.

Now make another mark on the rim of the flywheel with the same tram. You now have 2 marks on the rim of the wheel. Divide the distance between them and make another mark. By bringing this third mark to the height of the tram above the floor, the engine will then be correctly set on the inner dead center. The other dead center can be found in the same manner.

After the centers have once been accurately found points should be located and marked with a center-punch on some permanent portion of the frame and the flywheel and trams made. It will then be an easy matter to locate the centers in the future for making adjustments, etc. The engine now being on the dead center and the eccentric loose on the crankshaft and the rod, valve stem and valve in place, we can proceed as follows with the valve setting:

Shift the eccentric on the shaft until the valve has the desired lead, and temporarily fasten the eccentric to the shaft. Turn the engine in the direction it is to run until it is on the other dead center. If the lead is the same at both ends, the valve is correctly set; if it does not have the same lead the valve stem or eccentric rod must be lengthened or shortened until the lead is the same for both ends of the cylinder. If now

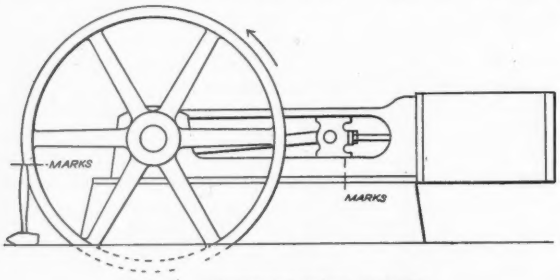


FIG. 1. FINDING DEAD CENTER

the lead is found to be more than desired, the eccentric must be turned backward, and if not lead enough is found the eccentric must be turned forward.

It is sometimes desired to have more lead on one end than on the other in special cases. This is often done on vertical engines or to equalize cutoff.

2. If the valve is already properly set and needs no other adjustments, the quickest way to reverse an

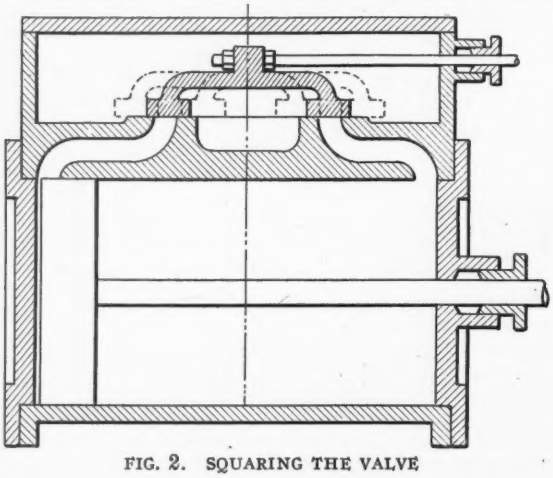


FIG. 2. SQUARING THE VALVE

engine is to put the engine on the inner dead center. Now make a mark with a lead pencil on the valve stem near the stuffing box gland. Then with the engine still on the dead center, shift the eccentric in the same direction that the engine ran at first until the mark made on the valve stem again comes up to the position it was at first placed. After the eccentric is fastened the engine will run in the opposite direction and the valve will be correctly set. This method saves the time of taking off the steam chest cover and replacing it.

The above operation could have been done with the crank on either dead center, but I assumed that it was an engine with a direct valve and used the inner center so the valve stem would move outwards and the lead pencil mark would not be rubbed off by entering the stuffing box.

3. Shaft governor engines usually have the flywheel or governor casing so designed with duplicate holes that by changing the weights, springs, etc., to these places on the opposite side of the casing or

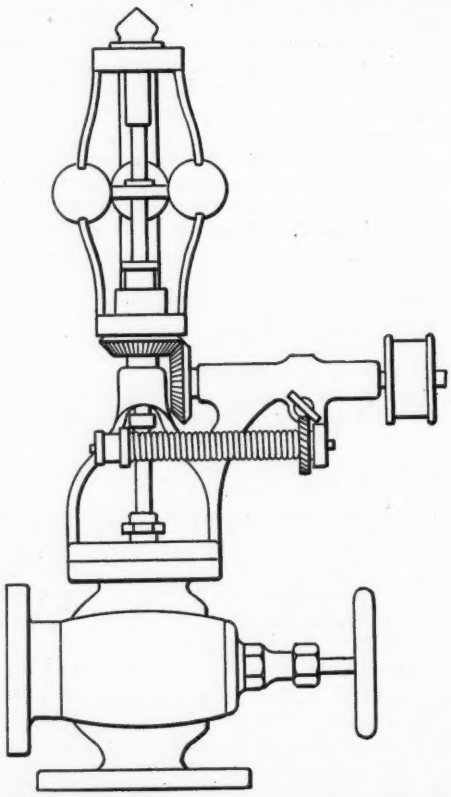


FIG. 3. THROTTLING GOVERNOR AND VALVE

wheel the engine will run in the reverse direction. By the changing of these parts the position of the eccentric is changed to the other side of the crank shaft.

4. A throttling governor is one which is placed in the steam pipe leading to the engine and regulates the speed by reducing the steam pressure to the pressure required by the load on the engine. This is called wire drawing of the steam.

It will be seen that with this type of governor it is necessary to carry a higher steam pressure than is usually required by the engine, due to the fact that, were the steam pressure not high enough and a heavy load were to come suddenly on the engine, it would slow down, hence in order to prevent this happening it is necessary to carry a higher steam pressure.

A shaft governor operates on an altogether different principle. It is placed in the flywheel or a casing made for that purpose, and controls the travel of the valve by shifting the throw of the eccentric. Instead of varying the steam pressure as does a throttling governor, it allows the full steam pressure to enter the cylinder and when enough steam has been admitted to do the work it is suddenly cut off and the rest of the stroke is carried on by the expansion of the steam.

5. An indirect valve is one which, due to its construction, must move in just the opposite direction to a direct valve. A direct valve in admitting steam to the cylinder moves in the same direction as the piston, but an indirect type of valve must move in the direction opposite to the piston at the point of admitting steam to cylinder.

In setting an indirect valve, care must be taken to place the eccentric in the proper position on the shaft. If a direct rocker or no rocker at all is used on the cutoff mechanism, it will be necessary to place the eccentric in a position on the shaft directly opposite to the position it would have were it driving a direct valve. That is, it must be placed 90 deg. less the angle of advance behind the crank. Piston valves are often of the indirect type, but it must not be assumed that all piston valves are of the indirect type.

6. A riding cutoff valve is an auxiliary valve used in conjunction with the plain slide valve, for the purpose of cutting the steam off early in the stroke and so securing the full benefit of the steam by expansion. This valve slides on the main valve and is driven by a separate eccentric. This valve does not affect the events of admission, release nor compression. These being controlled by a fixed eccentric as with any other common slide valve. Since the sole purpose of the riding cutoff valve is to control the point of cutoff, any change in the proportions of this valve or the position of its eccentric that will secure the desired change in cutoff may be made without affecting the other events in the steam distribution.

One well-known form of this valve, called the Meyer valve, is really constructed of 2 valves or

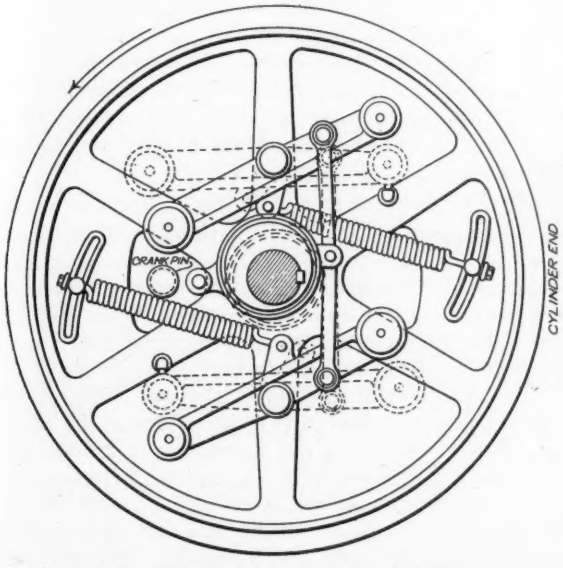


FIG. 4. SHAFT GOVERNOR AND ECCENTRIC

plates on 1 auxiliary valve stem, and they can be adjusted independently of each other. The valve stem is provided with right and left hand threads on the valve end. One of the valves is attached to the part of the stem having left hand threads and the other to the part having right hand threads. By turning the valve stem with a hand wheel on the outside of steam chest the cutoff can be adjusted at will and while the engine is running. By bringing the valves closer together the cutoff is made later and by drawing them farther apart the cutoff is made earlier. There is usually an indicating gage near the handwheel which indicates at what part of the stroke cutoff is taking place. The main valve, however, is constructed somewhat differently from the ordinary slide valve. It consists of a flat plate with a chamber on the under side for the exhaust steam the same as an ordinary valve, but the ends of the valve are extended so as to form passages or ports for the steam to flow through; these lead to the cylinder ports. The action of the valve is the same as any plain slide valve.

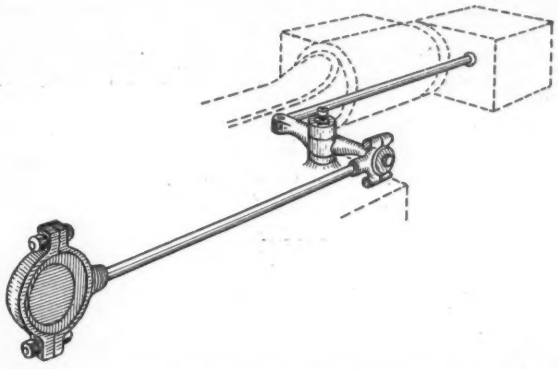


FIG. 5. INDIRECT VALVE AND ECCENTRIC SETTING

7. Usually, unless allowance has been made in the setting of the auxiliary riding cutoff valve, the cutoff for the ends of the cylinder will not be equal. This can be remedied by shifting slightly the faulty one of the 2 valves composing the auxiliary or riding cutoff valve. Bringing it nearer to its center of travel will cause later cutoff for that end and moving it farther away will cause it to cutoff earlier.

When a riding cutoff valve has once been properly set for a given cutoff, it can be adjusted a small amount for either earlier or later cutoff and still have practically equal cutoff for both ends, but this holds good within small limits only. When it is desired to change it a large amount, the auxiliary valve should be reset. The auxiliary valve eccentric is so set that when cutoff is taking place the cutoff valve and main valve are moving in opposite directions.

8. Compression is controlled by the main valve and is the same as any other ordinary slide valve, so this can be remedied by reducing the inside or exhaust lap. This change also causes the event of release to begin earlier. If admission were also too early the eccentric could be turned backward a little on the shaft.

A GOOD TEST

WHEN sizing up a young engineer carefully observe how he wipes up an engine. If he wipes off the dirtiest parts with slightly soiled waste or rags, using cleaner waste and rags as he approaches the final cleaning of the valve gear and polished parts, and winds up with waste or rags that do not show much stain when the cleaning is finished, it is a pretty fair indication that he is thorough and can be trusted with a job without being watched. The thorough discharging of detail work by assistant engineers is what later makes the first-class chief engineers.—Publicity Magazine.

THE BEST ENGINEER is the most indebted to others for his knowledge.

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TIME SAVING

Economy in small matters spells the difference between success and failure, when the margin is small. A saving of even an hour a day of lighting would mean a tremendous reduction in the coal bill of the country and remove by just so much the time when the coal supply will be exhausted.

For this reason, as well as for the saving on eyes and the gain in enjoyment, a suggestion recently made for gaining daylight looks sensible.

The idea of turning clocks forward in Spring and back in Fall has not met with approval, but our standard time is artificial anyway, and to extend eastern time as far as the Mississippi River will involve less difficulty than was experienced when standard time was adopted. It will add to the summer evenings an hour more of daylight for outdoor sports, and will bring the winter work day more nearly into the daylight hours.

It will benefit a great many people, simplify time tables and the doing of business and objections, other than that "it isn't so now" do not seem evident. The way to get it started is to talk about it.

OFF DUTY

It is well to forget at times that we are engineers and be just men. For after all the brotherhood of Man is greater than that of the Engineer and what a man is counts for more in his use to the world than what he does.

To all the question comes "Why are we here?" And turning the throttle, throwing the switch, cleaning the boiler, although they are daily tasks worth one's best endeavor do not seem to give full reason for the creation of a man.

Even when enjoyment is added, there seems still something wanting, but add the right to serve others and there is reason and ideal grand enough for all humanity. The Christmas season puts this thought into practice. It commemorates Him who came to serve and to teach the beauty of serving and it calls to us all to put this teaching into active work.

To all comes the impulse to make happy those who are near and dear, and to many comes the added opportunity to spread the happiness to others who might be left without the circle of cheer. Opportunity stands hammering at our doors forever, both for the gaining of material prosperity and for soul growth; and we stop our ears and brace the door shut and say, "I'm too busy. Haven't any time."

Habit is so easy to form and so hard to break—unless it is replaced by a different habit—that the impulse to wide kindliness is worth cherishing and giving full swing. No man can do enough good or give enough help to hurt him, and no good that he can do will hurt anyone.

So here's hoping that every one of the Practical Engineer Family makes for himself a happy Christmas and gets started in the habit so that he will continue with a Happy New Year.

INTERNAL FIRING WITH BITUMINOUS COAL

A STUDY OF COMBUSTION AND EFFICIENCY FROM ACTUAL TESTS

By David Moffat Myers

WITH THE OBJECT OF determining the economy of internal firing with bituminous coal, 2 thermal efficiency tests were conducted on an upright internally fired, fire-tube boiler, the principal dimensions of which were as follows:

Diameter of waist	74	in.
Furnace diameter outside	92.5	in.
Furnace diameter inside	84	in.
Furnace height inside	60.75	in.
Number tubes	284	in.
Diameter tubes	2.5	in.
Length tubes	15	ft.
Height of Boiler (bottom of water leg to end of top sheet)	20 ft.	6 in.

The grate was of the shaking variety and of area equal to the internal cross section of the fire box.

Two separate tests were made, the same man firing in both tests, complete results of which are given.

The high results obtained are a strong indication of the value of internal firing. They further suggest that the results obtained under forced conditions would have been much better if anthracite coal had been used; for in the second test there is a heavy loss due to the checked combustion of the naturally long flaming soft coal. This is known by the flue gas analysis, having large percentages of CO which were undoubtedly accompanied by an equally heavy loss of unburned and unchanged volatile hydrocarbons.

Cause of Combustion Loss

THE cause for this serious combustion loss is very simple. The distance from the grate surface to the lower tube sheet was only 5. ft. ¾ in. For complete combustion, the gases given off by the coal which are composed principally (with soft coal) of carbon monoxide and hydrocarbons of the CH_4 series must have sufficient time and space to become so thoroughly mixed with the air supply that each molecule of gas is in intimate contact with the necessary oxygen. This condition combined with high temperature will insure complete combustion.

But when it is attempted to force a soft coal fire with a restricted combustion space of a section no larger than the grate area and only about 5. ft. high, the result is that the air and fuel gases tend to be drawn by the draft in parallel lines, or strata, directly into the small cooling tubes without sufficient time or space to intermingle. Thus one of the most important requirements for complete combustion is lost.

As soon as these unburned fuel gases (CO and hydrocarbons) have entered the boiler tubes, their temperature is immediately reduced below that necessary for their combining; therefore, they go through the boiler and up to the stack, unburned, as absolute waste.

All this merely demonstrates the fact so often neglected by engineers and plant owners, that the manufacture of steam consists of 2 separate and distinct processes: (1) The development of the intrinsic heat of the fuel: (2) The absorption of this heat, by the boiler, after its full development in the furnace.

Action of the Internal Furnace

AN internally fired boiler is an ideal heat absorber, but its very high efficiency, as such, acts directly against good furnace conditions. One of the most important functions of a good furnace is to maintain a high temperature for the ignition and combustion of the gases.

Since a boiler is designed for the opposite purpose, that is, of reducing the temperature, it is evident that if high results are looked for the furnace and boiler

THERMAL EFFICIENCY TESTS ON AN UPRIGHT INTERNALLY-FIRED FIRE-TUBE BOILER

Kind of furnace, internally fired shaking grates.
Kind of boiler, upright fire tube.
Kind of fuel, bituminous run of mine.
Method of starting and stopping test, alternate.
Grate surface, sq. ft. 38.5
Superheating surface, sq. ft. 477
Water-heating surface, sq. ft. 1570
Ratio of water-heating surface to grate surface ..... 41.7 to 1

	At Normal Rating	Forcing Boiler
Date of trial	Apr. 20	Apr. 15
Duration of trial, hr.	6.033	7.033
Weight of coal, lb.	2774	6771
Percentage of moisture in coal	3.24	5.06
Equivalent water evaporated from and at 212 deg., lb.	27,637	58,951
Dry coal per sq. ft. of grate surface per hr., lb.	11.6	23.7
Equivalent evap. per hr. from and at 212 deg., lb.	4583	8385
Equivalent evap. per hr. per sq. ft. of heating surface, lb.	2.92	5.34
Steam pressure by gage (corrected), lb.	86.5	85
Temperature of feed water entering boiler, deg. F.	162	170
Temperature escaping gases from boiler, deg.	416	563
Temp. air entering ash-pit, deg.	59	74
Force of draught between damper and boiler, in. water	0.34	0.415
Force of draught over grate, in. water.	0.31	0.357
Total horse power developed, hp.	132.8	243
Builders' rated hp. at 12 sq. ft. h. s.	130.7	130.7
Percentage rated hp. developed. (Useful steam)	101.5	186
Economic Results		
Equivalent evaporation from and at 212 deg. per lb. of coal as fired, lb.	9.963	8.706
Equivalent evaporation per lb. of dry coal, lb.	10.3	9.17
Efficiency		
Calorific value of the dry coal, per lb.	14,011	13,034
Moisture in coal as fired, per cent.	3.24	5.06
Available heat in one lb. of coal as fired after deducting loss due to moisture and heat to evaporate the moisture, B.t.u.	13.518	12,310
Efficiency of boiler including grate based on the available heat in the coal as fired	71.17	68.30
Cost of coal per ton 2000 lb., f.o.b. factory	$3.90	$3.90
Cost of coal for evaporating 1000 lb. of water from and at 212 deg.	$0.189	$0.193
Average interval between firing, minutes.	11¼	6½
Average per cent CO_2	8.1	12.8
Average per cent O	11.9	4.7
Average per cent CO	0.27	2.72

functions should be separated. That is to say, the fuel should be completely consumed and its full heat developed before allowing the products of combustion to come into intimate contact with cooling surfaces.

Even when burning the short-flaming anthracite coals it has been found advantageous to interpose a fire brick arch between the burning fuel and the boiler heating surface.

The reduction of radiation losses by internal firing is a most important advantage. The loss due to the unburned gases by internal firing is a serious disadvantage.

By adding the advantage of a separate furnace or complete combustion to the advantage of internal firing, the most efficient plant would be the one that combined an efficient furnace with fire arch and large combustion chamber entirely surrounded by ample boiler heating surface.

Loss From Poor Combustion

THE loss due to unburned CO alone, in the forced test, assuming the coal to contain 80 per cent carbon, was the ratio of carbon monoxide to combined monoxide and dioxide, times per cent carbon in the coal, times 10,150 (the heat lost by burning only to monoxide). This becomes for the forced test $2.72 \div (12.8+2.72) \times 0.8 \times 10{,}150 = 1423$ B.t.u. per pound of coal. As the coal had a heat value of 13,034 B.t.u. per pound, the loss due to carbon monoxide was nearly 11 per cent.

Flame is a sign of incomplete combustion. Therefore, where boiler-heating surface is arranged for intimate contact with the flames of the fire, the result is the checking of combustion, by reducing the temperature below the ignition point, and a deposit of soot or smoke on the heating surface.

As a simple illustration, take a candle and hold a tin cup full of water just above the top of the flame and the flame will be almost white, showing a high temperature and smokeless combustion. Then lower the cup and hold it so that the bottom, which corresponds to the shell or heating surface of the boiler, is in the flame. Immediately the flame becomes dull and smoky and of low temperature and a thick deposit of soot or smoke forms on the bottom of the cup.

The same thing applies to flame from coal. In fact, the volatile portion of soft coal, which may constitute 36 per cent of its weight, will make a flame of about the same composition as that of a paraffine candle. The writer has seen flames from soft coal over 20 ft. long under a horizontal tubular boiler so that they curled up and entered the tubes after traveling the length of the boiler shell.

The principal reason that this internally-fired boiler gave better results at low rating (see test) was that with normal easy firing the fire received a larger percentage of air supply as shown by comparison of the flue gas analyses given in the table.

Large air supply produces a short flame and a reduced air supply a long flame. Thus in the normal rating test with large air supply the flame or combustion was practically completed before striking and entering the tubes. Whereas, in the forced test, the flame was long and did not have time or space to burn completely before being cooled by contact with the tube surfaces.

A forced fire generally produces a long flame, owing to the smaller proportion of air to coal. This may be simply demonstrated by closing off some of the air supply at the base of an ordinary kerosene lamp. As the air supply is reduced, the flame grows longer and duller until, finally, the flame will extend beyond the top of the chimney and dense smoke and unburned gases will be produced.

The tests on the boiler, here given, show the danger of depending upon carbon dioxide analyses alone to show boiler and furnace efficiency in even a comparative way on the same boiler.

Various forms of CO_2 machines are on the market and they have their field of decided usefulness. But their commercial promotion has misled a part of the engineering public into a serious misunderstanding of the principles underlying boiler and furnace efficiency.

Here is a case in point where such a machine would have told the fireman that when he forced his boiler the efficiency would be increased. As a matter of fact, the efficiency was actually reduced over 4 per cent and more coal was actually required per horsepower by increasing the percentage of CO_2 in the flue gases.

These machines do not show the losses due to unburned gases consisting of CO and hydrocarbons which caused the loss, in this case, to such an extent that these losses more than overbalanced the gain due to reduced air supply and increased carbon dioxide.

The fact that the boiler was forced to 86 per cent over its rated horsepower would not account for any of this loss for the reason that a boiler of this type in a series of tests was found to give the best economy at 100 per cent above its normal rating. But in this case the boiler was set on brickwork to give a longer travel to the flames before they impinged on the heating surface of the tubes.

Conclusion

THE upright fire-tube boiler showed comparatively high results under normal and high ratings in spite of heavy combustion losses under forced conditions.

2. The advantages of internal firing are principally due to decreased radiation loss and less floor space in boiler room.

3. The disadvantages of internal firing are (a) reduction of furnace temperature; (b) insufficient space or time for complete combustion, especially with volatile coals.

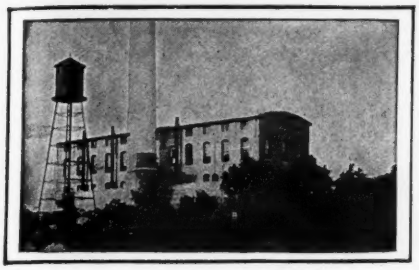
4. The tests emphasize the importance of considering steam production as involving 2 processes, (a) the development of the heat from the fuel by providing good combustion conditions; (b) the absorption of the heat after its development.

5. Large combustion space, or provision for the thorough mixing of the fuel gases with the air supply, is especially important when a fire is forced, which condition naturally produces a long flame with reduced air supply.

6. The long-flaming properties of volatile coals make them ill suited to the conditions for combustion provided by an internally fired boiler.

7. Boiler and furnace efficiency does not necessarily increase with a higher percentage of carbon dioxide in the flue gases. In the tests given, the CO_2 was increased from 8.1 per cent to 12.8 per cent with a reduction of efficiency of over 4 per cent.

8. An ideal boiler setting would be one providing internal firing, for the efficient absorption of the heat developed, combined with properly designed brick-lined or arched furnace with ample combustion space to allow high furnace temperature and complete combustion.



Power Apparatus

In Shop and Market

New Ideas in Making, Buying and Selling

"YANKEE" DRILL

THIS breast drill differs from others because of the number of combinations available when using it. It is carefully built as a machine shop tool for machinists and is nevertheless so simple that it is available for anyone to use, whether he be a mechanic or not. In many places for light work it is even more convenient than the bit brace for driving bits.

The special and peculiar feature is the shifter, which is placed on the cylinder between the small gears as shown in the illustrations. This is a thumb pin setting to different notches and the movement of this pin to the various notches changes the action of the tool without other adjustment.

In the notch nearest the chuck, Fig. 3, the drill acts as an ordinary breast drill. In the second notch it becomes a left-hand ratchet useful in removing taps or loosening the drill if it becomes jammed in a hole. The third notch acts as a right-hand ratchet for work where the handle cannot make a full revolution. In the fourth notch it serves as something different from any other drill that has been designed. The drill turns forward all the time with both forward and reverse motion of the handle, so that no time is lost in drilling and the very least motion of the handle will serve to turn the drill; a motion of a quarter-inch back and forth of the handle serves to drill the hole, making it usable in the most cramped situations. The ratchet action used here is positive and the makers, the North Bros. Mfg. Co., of Philadelphia, guarantee that it cannot get out of order.

In the fifth notch, farthest from the chuck, the spindle is locked tight so that the drill clutch can be rapidly opened or closed. It is evident that this drill by the simplest movement of a shifter gives all possible motions that can be desired. In the double speed drill Fig. 2, a change speed lever is provided on the shank of the hand crank, giving 2 speeds with any of the combinations secured by movement of the shifter pin. Change in speed can, therefore, be done in a small part of a revolution and even while the work is under way. It is a convenience when striking hard spots or when drilling through 2 materials of different hardness.

The side handle is removable by unscrewing and it has on the end a screw driver suited to handle all the screws in the drill. The breast plate can be adjusted parallel with the driving handle or at right angles to it, as may be desired, so that the tool can be used close against partitions or in corners. Adjustable ball bearings are used on the spindle so that all wear can be taken up and the thrust provided for.

FIG. 1. YANKEE BREAST DRILL WITH 3-JAW CHUCK FOR ROUND DRILLS

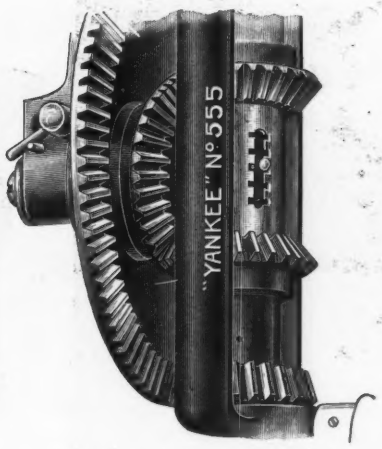


FIG. 3. DUPLEX ACTION OF YANKEE DRILL

FIG. 2. 2-JAW CHUCK ON SMALLER SIZE YANKEE DRILL

Two forms of chuck are provided, one with 2 jaws Fig. 2 and the other with 3, Fig. 1. The 2-jaw chuck will hold accurately and securely either round or square shank drills or other tools up to ½ in. diameter. The hexagon at the end of the chuck permits the use of a monkey wrench for tightening large drills.

In materials and finish the "Yankee" drill corresponds to the completeness of its design as a convenient working apparatus. The 3-jaw chuck is of the ordinary drill design made to hold round shanks, while the 2-jaw chuck is fitted to hold the square ends of wood augers. This drill is made in smaller sizes for drills up to ⅜ in. and can be furnished with the single speed if desired at a somewhat less cost than for the standard drill.

BALATA BELTING FACTORY

ANNOUNCEMENT is made that a combination of German and American capital has been brought together for the building of a great Balata belting factory in the United States. Though hundreds of thousands of feet of Balata belting are in service for transmission purposes in the United States at the present time, none of it is manufactured in America. That a syndicate has been formed to introduce this new manufacturing interest into the United States will therefore be of interest to those who use large quantities of this kind of belting.

The corporation behind the new enterprise is known as the Victor-Balata and Textile Belting Co. The American interests represented in the new company are Charles E. Aaron and John R. Stein, president and treasurer, respectively of the New York Leather Belting Co. of New York City. The German interests are represented in the new company by William Vollrath, Albert Vollrath and Edwin Vollrath of the firm of C. Vollrath & Son of Blankenburgh, Germany.

Building the new plant will entail an expenditure of half a million dollars in buildings and equipment which will be located at Easton, Pa. Work on the first buildings of the new plant will be begun immediately.

The factory site covers 9 acres of ground and is located to the westward of Easton in a suburb known as Palmer. So important is the project, however, that the city of Easton will extend its limits to take the new plant within its borders to give it the benefit of fire protection. A 1000-ft. siding is being built at the present time by the Lehigh Valley R. R. from its main tracks to the factory site to handle the freight.

WATTLES STOKING REGISTER

THIS is designed to give a complete record of the density of smoke in a chimney during 24 hr. thus recording exact conditions in the stack with the object of decreasing coal consumption and eliminating smoke nuisance. As shown in Fig. 1, on one side of the boiler flue there is an electric lamp and on the opposite side is the register containing sensitized white paper in dial form fixed on the shaft of the clock. This dial covers a complete 24-hr. day, 12 hr. on the outer circle of the register, shown in Fig. 2, and 12 hr. on the inner circle. The lamp and dial mechanism are each placed in a sheet iron cone at the end away from the flue and far enough from it so as not to be in contact with hot gases or become

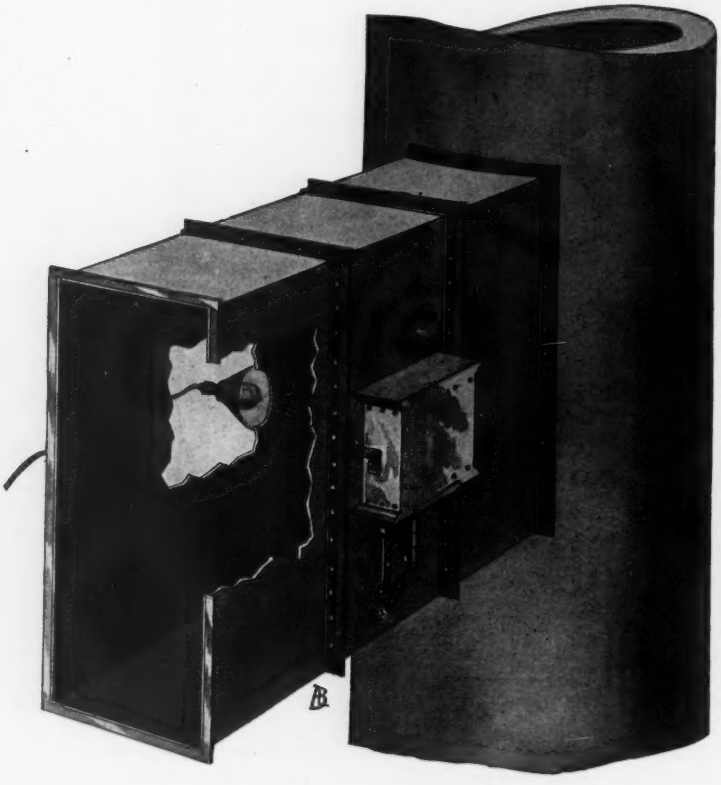


FIG. 1. ATTACHMENT OF WATTLES REGISTER TO FLUE

FIG. 3. THE WATTLES REGISTER, FRONT VIEW

dirty. Air holes around the lamp allow of sufficient circulation to keep it cool.

In front of the dial, toward the flue, is a door with 2 slots, one opposite the outer surface, the other opposite the inner, a tripping device serving to change from one opening to the other at the end of each 12-hr. period. The disk must be removed and developed each 24 hr. and gives then a complete photographic record of the smoke conditions in the flue. The white record, therefore, indicates heavy smoke in the flue, which obscures the rays of the electric light, while a black record indicates no smoke.

Chart 1 is an illustration of good firing, indicating that the flue was practically free of smoke throughout the 24 hr., while chart 2 of Fig. 2 shows poor firing and a chimney frequently filled with dense smoke. Figure 3 shows the side of the register which goes next the flue and the opening through which the light from the lamp is carried to the sensitized disk of paper.

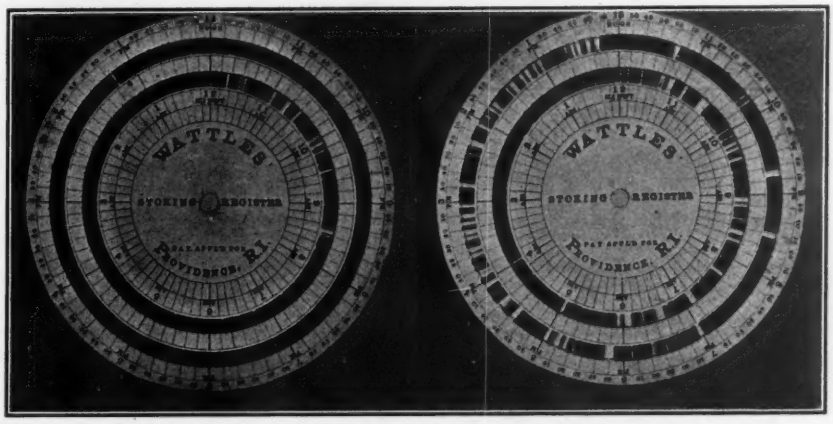


FIG. 2. RECORDS FROM WATTLES STOKING REGISTER

FEED-WATER HEATERS AND RECEIVERS FOR CLOSE QUARTERS

AMONG the most essential parts of an exhaust steam heating system are the oil separator to remove cylinder oil from the exhaust steam before the latter passes to the heating system, and a receiver or return tank to which the condensate can be brought back before being pumped into the boiler. This tank usually takes the form of an open feed-water heater and part of the exhaust steam is used for reheating the returns to 210 deg. F., or thereabouts, before they are pumped into the boiler.

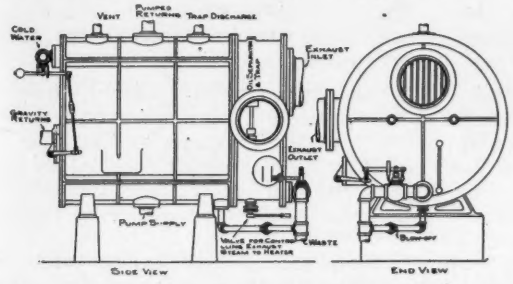


FIG. 1. COCHRANE HEATER AND RECEIVER FOR CLOSE QUARTERS

Harrison Safety Boiler Works, of Philadelphia, has brought out an improved type of heater and receiver, combined with an extra large separator and fitted with valves so that the separator can remain in service while the heater itself is cut out of circuit for inspection or cleaning. This combined apparatus replaces a considerable amount of apparatus, and saves a corresponding amount of space in boiler rooms, which is important in large office and other buildings. Frequently, however, there is not head room enough for the upright rectangular type of heater and receiver, in which case the horizontal, cylindrical form, fitted with the surplus exhaust or steam stack type of separator, as shown in Fig. 1, is used.

The apparatus shown in the illustration is peculiar in that the steam stack is not at the top of the separator, as is ordinarily the case, but from the side, still further reducing the amount of head room required. The separator covers the whole end of the heater, or rather the separator and the drainage trap which disposes of the drips from the separator and of the overflow from the heater are both contained within the ring casting at the end of the heater, the shell of the heater being constructed something like that of a cylindrical surface condenser. A circular plate closes the end of the heater body proper and contains the port through which the steam enters the heater and the opening through which the waste from the heater overflow or skimming weir escapes into the trap. The

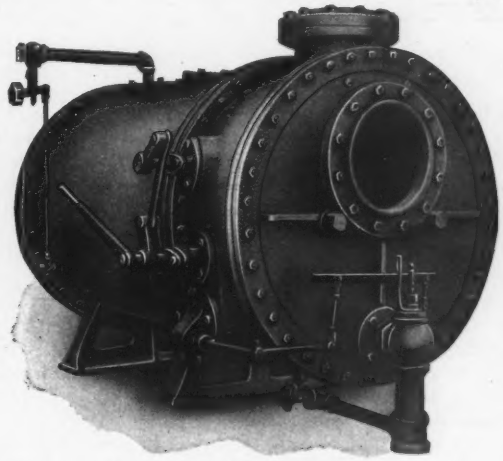
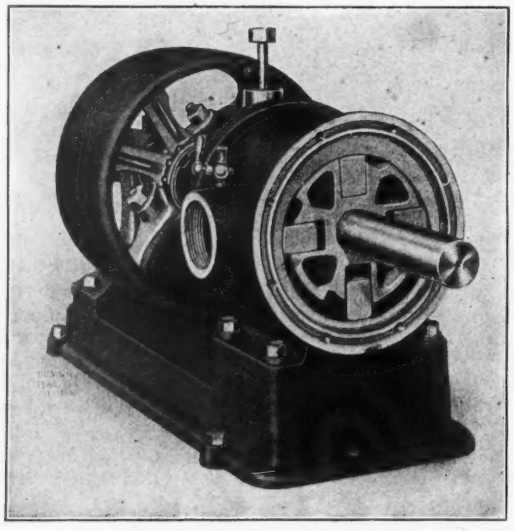


FIG. 2. COCHRANE HEATER WITH EXHAUST TOP

separator ring is bolted fast against the plate. At one side of the separator casting is the surplus exhaust outlet, and below is the stuffing box for the lever to which is attached the float that operates the valve draining the trap.

Two semi-cylindrical valves on a common spindle serve to close the steam opening simultaneously, and thus to shut the separator off from the body of the heater when the latter is to be opened for cleaning or inspection while the heating system remains in operation. At the top of the spindle is a handle swinging horizontally under the end of the heater shell. The separator baffle plate, which serves to arrest the particles of oil and moisture carried by the current of exhaust steam entering the separator, is attached to the front cover plate of the separator, the steam passing around 1 side and then behind the baffle. When the steam valve is open, the steam deflected into the heater, the remainder of the exhaust steam passing to the surplus exhaust outlet.

At the opposite end of the heater shell are the cold water inlet and the float mechanism controlling the flow of water according to the level of the water in



CURTIS ROTARY PUMP WITH HEAD REMOVED TO SHOW ROTOR

the heater. The opening for gravity returns is also at this end, as is the door for removing the trays over which the water is sprayed in the top of the heater, and the door for removing precipitated impurities and filtering material from the bottom part of the settling chamber.

The heater and receiver shown in Fig. 2 differs from the heater described above in that the exhaust outlet is at the top of the separator ring, and valves are arranged on horizontal spindles connected to a common valve gear and handle, and the float controlling the cold water inlet valve is attached to a spindle passing in through the main heater shell instead of through the rear end plate.

The principal feature of interest about this heater is the use to which it has been put. It is installed between a steam engine and an absorption refrigerating machine, purifying of oil the exhaust steam passing to the refrigerating machine and receiving the condensed returns from the latter and such make-up water as may be required, and heating it up to 210 deg. F. for boiler feed. In order to be able to operate the ammonia generator at any desired pressure, the heater has been made with a solid shell to withstand a maximum pressure of 40 lb.

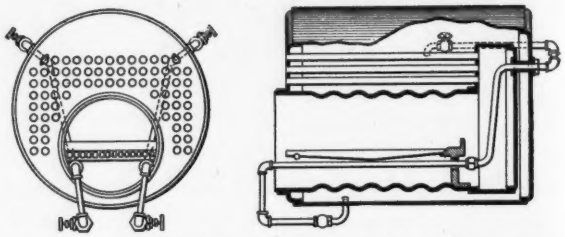
CURTIS ROTARY PUMP

THIS pump, which is made by the Pittsburg Machine Tool Co., of Pittsburg, Pa., has novel features which commend it to the interest of the engineer. It consists of an outside casing or body into which a lining is pressed, this lining being of eccentric shape, as shown in the view herewith, which has the end of the pump casing removed. On each end is a head fastened to the body with studs and bolts and inside this are auxiliary bronze heads fitted into a recess in the pump body. Within the eccentric casing is a revolving member provided with slots in which the buckets slide, these buckets in the larger size being made of tough wood and in smaller size of acid-resisting metal.

Dirt pockets are provided in the head of the buckets to catch any solid substance that may pass through the pump and thus prevent the cutting of the rotor and the lining. Discharge pressure holds the pockets out against the lining and the charge is taken in from the suction pipe as the bucket passes by the inlet opening. The pump may be driven by motor with gear and pinion or by belt, as shown in the illustration. It is a positive acting pump, will work successfully on either high or low heads and is made in capacities up to 500 gal.

NEWHALL AUTOMATIC WATER CIRCULATING DEVICE

SHOWN in the figure herewith, is a device designed especially for increasing the circulation, maintaining it positive and constant in Scotch marine and continental types of boilers. On each side of the boiler near the lower part of the shell, pipes are tapped in with suitable valves connected to hori-



NEWHALL AUTOMATIC WATER CIRCULATING DEVICE ATTACHED TO MARINE TYPE BOILER

zontal runs. These taps are made near the front end of the shell and horizontal runs are carried forward then up and back under the grates and inclined runs are then carried through the back combustion chamber out through the rear water space and returning on the outside of the shell enter just below the water line.

The heat in the back combustion chamber causes rapid upward motion of the water in the pipes and water is thereby drawn from the shell underneath the furnace and carried upward and discharged near the water line. The valves in the circulating pipes permit of regulation of the circulation as desired. Flue-gas circulation is within the shell of the boiler in the usual way.

Lack of rapid circulation is the only weak point in the action of Scotch marine and continental boilers and the

action of the Newhall circulating device, taking water away from that part of the boiler where it receives no heat from the furnace, and discharging it into the part where the tubes are active in heating the water, increases the capacity of the boiler, equalizes the temperature of top and bottom, thus relieving expansion strains and avoiding accumulation of scale and sediment to choke the space beneath the furnace.

The device is automatic in action and by opening the bottom valves and partly closing the upper ones, the water may be greatly heated before returning to the boiler, or by partly closing the bottom valves and opening the upper ones, the circulation may be made very rapid. The Newhall circulator is the invention of Frank H. Newhall, Juneau, Alaska.

THE QUALITIES AND USE OF FIBROUS SHEET PACKING

AMONG recent comers in the packing field the fibrous sheet is one of the newest and has many properties which make it desirable for severe conditions. It is light, yet strong, and does not soften under the action of heat, thus it avoids crawling and shrinkage; it is yielding so that it conforms to imperfect and rough surfaces, seating to good advantage and keeping the joints tight, yet it is durable so that it will last indefinitely under normal conditions.

Since it has a firm surface with a yielding inner body, where the flanges are smooth or carefully faced fibrous packing can be used in thin sheets, giving better opportunity for the packing to hold a high steam pressure. The fibrous is noncorrodable and cannot be affected by chemicals in the water which results from condensation of steam.

Fibrous packing is of such material that it does not lessen in value as time goes by, hence may be carried in stock for an indefinite time. One particular brand, the Vanda packing, made by the Vanda Co., of New York City, is impregnated with graphite so that it does not mix with water, even though condensation may settle into the joints. Also it is unaffected by heat and oil and can be used successfully for hot or cold water, air, ammonia, gas and superheated or saturated steam under either low or high pressure. Where the flanges of a pipe joint are rough, it is advisable to use packing a full 1-16-in. thick, and this is also advisable in packing joints for pipe lines carrying ammonia, air or cold water.

Since fibrous packing is tough of its own nature, it requires no wire insertion even when used with the highest temperature and pressures. When used for gas engines, for which it is suitable in most conditions, the 1-32-in. sheet should be applied. The Vanda packing already mentioned instead of coming in rolls is sent out in sheets 4.5 ft. square or can be, for special requirements, 4.5 by 9 ft. When cutting this the best results can be obtained by using curved shears such as the tinner's snip, or a sharp knife.

Fibrous packing, when once in place and the joints tightened up, does not shrink, so that following up of the joints is not necessary. Also, the use of a thin packing, which is possible in the fibrous form, makes less plastic material and the joints do not, therefore, take up so much in making up the pipe. In cases where there is extraordinary vibration in the pipe under steam pressures of 350 lb., air pressure of 950 lb., and hydraulic pressure of 1800 lb., tests have shown that this style of packing gives very satisfactory results.

LECTURE SUBJECTS

FROM the State Educational Committee of the N. A. S. E. for Massachusetts comes an interesting list of the speakers for associations in that state during the coming year. It includes specialists in every line of power plant activity from the construction of the building itself up through all apparatus installed and to all kinds of applications such as motors, refrigerating plants, steam heating and even including the proper methods for industrial education as well as for industrial operation. There is certainly no good reason why associations in Massachusetts should not have interesting lecture courses throughout the winter and as it is probable that by writing direct to them these speakers could be engaged for meetings in other states and by any associations of engineers who might be looking for good lectures, it seems worth while to print the list in full.

Combustion, and Flywheel Explosions; Howard P. Fairfield, Instructor in Machine Construction, Worcester Polytechnic Institute, Worcester, Mass.

Installation and Operation of Electrical Machinery; Carl D. Knight, Asst. Prof. of Experimental Engineering, Worcester Polytechnic Institute, Worcester, Mass.

Heat Treatment of Steel; Newton E. Putney, 29 Central Street, Southbridge, Mass.

Pump Troubles, and Vacuum Pumps and Condensers; Henry M. Chase, Mech. Engr., with Dean Steam Pump Co., Holyoke, Mass.

Foundry Practice As Related to Steam Engineering; Reginald H. Palmer, Instructor in Foundry Practice, Worcester Polytechnic Institute, Worcester, Mass.

Use of Concrete in Mill Plants; Arthur W. French, Prof. Civil Engineering, Worcester Polytechnic Institute, Worcester, Mass.

Industrial Education; Elmer H. Fish, Manager Worcester Trade School, Worcester Trade School, Worcester, Mass.

Manufacture and Testing of Cement; Edward L. Hancock, Prof. of Applied Mechanics, Worcester Polytechnic Institute, Worcester, Mass.

How Water Becomes Steam with Some Experiments; A. Wilmer Duff, Prof. of Physics, Worcester Polytechnic Institute, Worcester, Mass.

History and Development of Pressure Gages; William W. Webb, 25 Clinton Street, Cambridge, Mass.

Engineering Reminiscence; A. L. Mertrud, 39 Fisher Street, Lowell, Mass.

Three-Phase Alternators; Their Care and Operation; William S. Trofatter, 51 Jaques Street, Somerville, Mass.

Modern Steam Traps; Jarvis Smethurst, 455 Brayton Avenue, Fall River, Mass.

Any Subject Pertaining to Steam Engineering Your Association Desires; Thomas Hawley, 115 Huntington Avenue, Boston, Mass.

Gas Engines and Producers; William F. O'Regan, 3 Ascot Street, Brighton, Mass.

Gas Engines; F. S. Leavitt, 68 Grandville Avenue, Malden, Mass.

Care and Management of Steam Boilers; P. H. Hogan, 8 Oliver Street, Boston, Mass.

Running Condensing; Pearl E. Merriam, Methuen, Mass.

Boiler Setting to Aid Proper Combustion. Proper Combustion to Economize for the Man Who Pays the Bills; John H. Foote, McLeod & Henry Co., 1402 Broadway, New York, N. Y.

Coal Pile to Switchboard; George Wood, 105 Judson Street, Malden, Mass.

Elevators; James Duncan, Power Dept., Jordan Marsh Co., Boston, Mass.

The Steam Turbine, Engine Room Practice, Condensers; Fred L. Johnson, 505 Pearl Street, New York.

The Manufacture and Distribution of Illuminating Gas; James H. Sumner, 43 Allston Street, Cambridge, Mass.

Steam Heating Systems; James A. Donnelly, 132 Nassau Street, New York.

Economical Boiler Room Practice; E. G. Bailey, 220 Devonshire Street, Boston, Mass.

Steam Pumps and Their Management; E. P. Howard, Int. Pump. Co., 42 Batterymarch Street, Boston, Mass.

The Automatic Engine, Its Erection and Operation, Engine Governors; A. W. Barnes, 49 Federal Street, Boston, Mass.

Refrigeration and Refrigerating Apparatus; C. W. Boyer, 364 Somerville Avenue, Somerville, Mass.

Boiler Design; W. K. Campbell, Cambridge Iron Works, Cambridge, Mass.

Economical Lubrication of Power Plants; William M. Davis, Lubricating Engineer, 93 Broad Street, Boston, Mass.

The Compound Engine; F. A. Garrow, P. O. Box 146, Chicopee Falls, Mass.

The Water Tube Boiler; James V. V. Colwell, 176 Federal Street, Boston, Mass.

Superheaters; H. S. Brown, 10 Post Office Square, Boston, Mass.

Steam Engines and Their Repairs; E. H. Carey, 530 Albany Street, Boston, Mass.

Heat and Its Application to Engines and Boilers; J. G. Crowdes, 76 Oliver Street, Boston, Mass.

The Steam Engine Indicator, The Steam Gage and Safety Valve; Mr. Burnham, Crosby Steam Gage & Valve Co., 97 Oliver Street, Boston, Mass.

Refrigeration; George L. Finch, Blake Mfg. Co., Cambridge, Mass.

The Steam Turbine; C. B. Burleigh, General Electric Co., Boston, Mass.

Heating and Ventilating, Fundamental Principles of Engineering; Albert S. Smith, Massachusetts Institute of Technology, Boston, Mass.

The Operation and Application of the Fuel Calorimeter; Charles J. Emerson, 251 Causeway Street, Boston, Mass.

Refrigeration; S. K. Page, 27 Stanton Street, Maplewood, Mass.

Variable Speed Paper Mill Engines; F. R. C. Boyd, The Ball Engine Co., Board of Trade Bldg., Boston, Mass.

Practical Combustion, Smoke Abatement; John S. Schumaker, 141 Milk Street, Boston, Mass.

Analyzing Flue Gases, Demonstration of Use of Combustion Gage or Orsat; K. E. Terry, 141 Milk Street, Boston, Mass.

Draft; A. E. Selig, 84 State Street, Boston, Mass.

MEN DO NOT confide themselves to boys, or coxcombs, or pendants, but to their peers.—Emerson.

STEAM ENGINEER'S LICENSE IN HUNTINGTON, W. VA.

RECENTLY a new ordinance has been adopted by the city of Huntington regulating the operation of steam engines in the city and providing for the examination of those who are to have charge of steam plants. The provisions of the ordinance are as follows:

The board of engineers consists of 4 appointed by the board of commissioners and at the present time is made up of R. D. Wylie, chairman, E. W. Winn, secretary, C. L. Humphries, treasurer, and H. E. Huntington, examiner. All persons connected with this board must be competent and practical engineers, with at least 10 years' experience in the work.

It is the duty of the chairman of the board to examine boilers at least once annually and keep a record of the names of owners and the uses of the boilers, giving full description. For such inspection $3 is the fee, and certificate is granted for the pressure deemed safe. Failure to have a boiler inspected is punishable by a fine of not more than $100, and carrying greater pressure than permitted, by a fine of from $10 to $100, and if the fault is that of the engineer his license shall be revoked.

Boilers which are kept insured in a legitimate insurance company which requires inspection, those used for heating private dwellings, and locomotive boilers are exempt from inspection.

For examination of engineers the fee is $3 and license is granted for a term of one year, when it is renewed on the payment of $2 without examination if the application for renewal be made before the expiration of the license. An applicant who fails on his examination may not apply again for 2 months.

Anyone operating a boiler without a certificate is subject to a fine of from $5 to $50 for each offense, but in the case of emergency an employer may secure the services of a competent person without certificate for 10 days.

Receipts from fees are paid into the city treasury and are used, first, for payment of expenses of the board, each member receiving a salary of $25 a year, and the other expenses of boiler inspection, etc., after which the balance goes into the contingent fund of the city.

An engineer who has been operating a plant for a year may, on certificate from his employer, be granted a permit to continue to act as engineer on that plant for one year without examination, but at the end of that time must pass examination in the regular way.

Three classes have been established by the examiners, the first those passing with grade of 85 per cent and having the right to operate any steam plant, the second requiring 70 per cent and giving the right to operate any plant up to 250 horsepower, the third being a permit to run a plant up to 75 horsepower for one year. Up to the 15th of November 71 engineers had passed the examination and received their papers.

NEWS NOTES

A NEW YORK AGENCY in charge of Frank Boyle, has been opened by the Homestead Valve Mfg. Co. at No. 1135 Park Row Building, New York, for the purpose of handling the sales of Homestead valves in that vicinity. A complete stock will be kept on hand at all times and Mr. Boyle will be pleased to hear from the users, and prospective users of Homestead valves when in the market.

AFTER SOME 5 YR. of service as engineer and superintendent of the Sight Feed Oil Pump Co. and its successor, the Richardson-Phenix Co., of Milwaukee, Robert R. Keith has resigned his position and is now journeying through the far west for a change and rest before taking up further activity in the power plant manufacturing field.

OWING TO GREAT increase in its business on the Pacific Coast, Pawling & Harnischfeger Co., of Milwaukee, has opened a branch office in Portland, Ore., which will be in charge of R. K. Morse. Mr. Morse has for some years been a member of the engineering staff at the Milwaukee office and is qualified not only to take up engineering problems but also as sales representative. He will handle the complete line of cranes, hoists and lumber-handling apparatus manufactured by the company.

THE ANNUAL MEETING of the Practical Refrigeration Engineers' Association will be held in Shreveport, La., Dec. 1-3. This organization is for the advancement of its members in the art and science of refrigerating engineering, and at the meeting papers will be read and discussion had on matters connected with the practical handling of refrigerating plants. The mutual benefit of employer and employe are the objects in mind, and a large attendance at the meeting is desired and expected. Further information can be had from J. B. Embrey, Box 178, Shreveport, La.

HERBERT E. STONE has accepted a position as New England manager of the Elliott Co. of Pittsburg, Pa., which supersedes the Liberty Mfg. Co., and will in the future represent the Elliott Co. in the New England territory. Mr. Stone will have his offices at 102 High St., Boston, Mass., and is congratulating himself that after years of enforced absence he is now able to get back to his home town and among old friends for his activities. The telephone number will be 1633 Fort Hill and friends of Mr. Stone or of the company will be gladly welcomed at the offices at all times for business or for their convenience.

THE 3RD INTERNATIONAL CONGRESS of the Refrigerating Industries will be held in the United States in 1913, in accordance with the 2nd Congress just closed at Vienna. The educational value of these conferences is evident, as refrigerating engineers and experts in this country are enabled to meet men in similar pursuits in other countries and to compare notes on construction and operation of refrigerating plants. The interests of the American Association of Refrigeration, and the best way to get in touch with the helps available is through membership in the American Association. F. W. Pilsbry, Monadnock Block, Chicago, is in position to give information.

INCREASE OF BUSINESS because of merit of product always means a call for larger quarters and this pleasant experience has come to the Betson Plastic Fire Brick Co. of Rome, N. Y., which has recently moved into a 2-story brick building to get more room and has been obliged to add considerably to equipment and facilities for furnishing the Plastic Fire Brick ready for application to any form of construction.

MCCLAVE-BROOKS CO. has recently opened an office in the Fulton Building, 50 Church St., New York, with S. C. Smith as manager, where anybody in that district desiring stokers, shaking and cut-off grates or Argand steam blowers will have his needs carefully attended to.

IF A MAN empties his purse into his head, no man can take it way from him. An investment in knowledge always pays the best interest.—Franklin.

BOOKS AND CATALOGS

HAND BOOK FOR MILLWRIGHTS, by C. F. Swingle. 400 pages, illustrated and fully indexed, cloth binding, 5 by 8 in. Price $2.

This is a useful book for those having to do with the up-keep of machinery in mills and covers the subjects of excavation, foundations, roofs and trusses, steel beams and girders, shafting and its erection, belt drive, rope transmission, wheel gearing, lubrication, setting of engines, setting of boilers, the erection of smoke stacks, pipe connections, utilization of water power, the hydraulic ram. It is obvious that the treatment of each subject must be rather brief to cover so many in the amount of space allotted, but the book is to the point and gives most of the elementary information that one would need to use in taking care of the installation and detail work up to the point where specialists should be called in.

POWER GAS AND THE GAS PRODUCER is the title of a book by J. C. Miller, having 192 pages, fully illustrated, well indexed, cloth bound, selling at a price of $1. It is an American book by an author who has made a special study of this subject and has been teaching it to practical engineers for a number of years. It deals first with the chemistry of gas production, gas producers and the gases which they make, showing the heat values of the different kinds and the fuels from which the gases may be made, then takes up gas producer operation, comparing its efficiency with that of the steam plant and giving the requirements in regard to grate area and producer capacity. Gas and steam power costs, reliability of gas power and the installation and care of gas producers complete the book. The most common American makes of producers are described and illustrated.

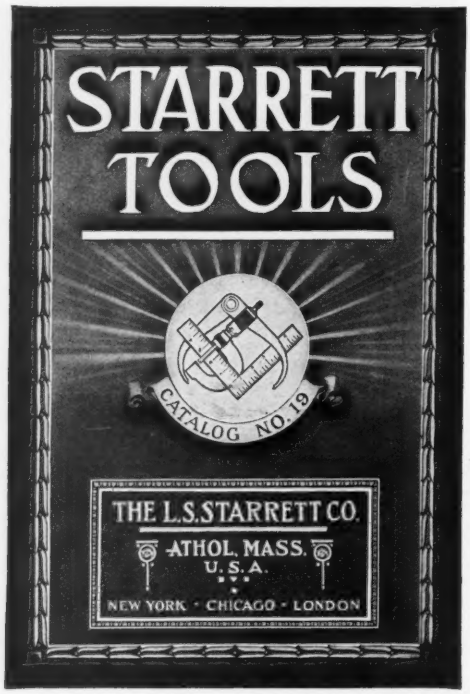
THE 19TH annual Revised Edition of Hendricks' Commercial Register of the United States for Buyers and Sellers has just been issued. It is by far the most complete edition of this work so far published. The 18th edition required eighty-seven pages to index its contents, while the 19th edition requires one hundred pages, or thirteen additional pages. As there are upwards of four hundred classifications on each page, the thirteen additional pages represent the manufacturers of over five thousand articles, none of which have appeared in any previous edition. The total number of classifications in the book is 35,481, each representing some machine, tool, specialty or material required in the architectural, engineering, mechanical, electrical, railroad, mine and kindred industries, the whole representing upwards of 350,000 names and addresses. Classifications are so arranged that the book can be used for either purchasing or mailing purposes. The trade names of all articles classified as far as they can be secured are included in parentheses between the names and addresses under the classifications where they appear. The book is revised, improved and issued annually and has been since 1891. It is expressed to any part of the country on receipt of $10 by S. E. Hendricks Co., 74 Lafayette St., N. Y.

FROM THE VULCAN SOOT CLEANER CO., of Pittsburg, Pa., comes a new catalog describing how to produce power more economically by the use of the Vulcan soot blower for water-tube boilers. The illustrations show the application of the blower to horizontal and vertical arrangements of water-tube boilers and to the Manning vertical fire-tube.

FROM THE BRISTOL CO., of Waterbury, Conn., we are in receipt of a number of interesting bulletins of standard size showing by illustrations and descriptive matter the various uses to which the Bristol recording

gages and electrical instruments may be put. No. 128 describes the round form recording thermometer, No. 129 the thermometer thermostats, No. 135 the recording shunt ammeters for all ranges of direct current, 141 the round form pressure recording gages, 145 indicating thermometers for high temperatures, 146 the long distance recording tachometer for giving shaft speeds, 147 the Bristol-Durand averaging instrument for measuring areas on a round chart. In all bulletins describing instruments the different scales which are provided are shown full size.

STARRETT'S TOOLS are recognized as a standard of value and of workmanship and in the field of machinists' and engineers' tools which it covers the L. S. Starrett Co. has an enviable standing. A list of its products is, therefore, a necessary part of a working library and the new Catalog No. 19, which is brought up to date, contains several new devices of interest. Among



these are protractors, a new size of scriber, extension pliers which have the quality of a wrench as well as a plier, scrapers, a new speed indicator with rubber handle, a screw pitch gage with increased number of pitches, and various tools of more direct interest to the machinist. The catalog contains 274 pages of good information and can be had by writing to the L. S. Starrett Co., Athol, Mass.

AUTOMATIC CONTROLLING VALVES as made by the Ideal Automatic Mfg. Co., of New York City, are the subject of a booklet which illustrates and describes the pump governor in automatic form and in the compound pressure form, the pressure controlling valve, steam pressure regulator and hydraulic ram pressure controlling valve.

THE EFFECT OF KEYWAYS on the Strength of Shafts, by Herbert F. Moore, has just been issued as Bulletin No. 42 of the Engineering Experiment Station of the University of Illinois. This bulletin gives the results of tests to determine the relative strength of solid shafts and of shafts with keyways. A table showing power transmission by cold-rolled shafting with keyways and a diagram illustrating the weakening effect of keyways are given. Copies of Bulletin No. 42 may be obtained gratis upon application to W. F. M. Goss, University of Illinois, Urbana, Illinois.

FROM GUSTAV WIEDEKE & CO., of Dayton, Ohio, comes Ideal Bulletin No. 30, explaining the operation of the tube expanders, caulking tools, beading tools and other devices for putting in boiler tubes made by this company. Those having daily work with boilers will find the comparison of the different forms of tools of greatest interest.

LORD'S GIRL is one whom any man would be glad to meet and while unfortunately they have not an unlimited supply of the original, they have some of her portraits which can be obtained by writing to the Geo. W. Lord Co., 2238 N. 9th St., Philadelphia. Every engineer who has met the lady says she is one of the finest looking he ever saw and you will enjoy making her acquaintance.

THE TREATMENT OF BOILER FEED WATERS is an interesting and attractive booklet issued by the Dearborn Drug & Chemical Works, of Chicago. It tells of the impurities which must be removed from feed water to have it most efficient in boilers, gives tables of loss from scale, shows examples of corrosion and of scaling as the result of impure waters, and describes the method used by the Dearborn Co. for overcoming these difficulties. The booklet will be found good reading by all who have anything to do with boiler practice and can be obtained by writing to the Dearborn Drug & Chemical Works direct.

TERRY STEAM TURBINES are applied for a great number of uses, one of the latest being for the driving of gas blowers. The gas blower is a booster used in an illuminating gas system for increasing pressure in the mains above that produced by the weight on the gas holder, and the Terry turbine gas blower set is composed of a turbine direct connected to a pressure blower, the turbine being arranged to run either noncondensing or condensing, as plant requirements make desirable. The same arrangement can be used for cupola blowers for foundries and for forced draft and ventilating sets. These sets are made from 6 to 133 hp. with actual capacity in cubic feet of air per minute from 725 to 16,300. Copies of the bulletin may be obtained from the Terry Steam Turbine Co., 90 West St., New York.

FROM THE BALTIMORE RETORT & FIRE BRICK CO. comes Bulletin No. 2 on Fire Brick and Special Boiler Settings, describing the T. & G. arch lintles, grate blocker, 3-piece arches, 2-piece and 1-piece arches, and solid piers, patent button brick for arches, hollow tile and protector tile for smokeless furnace construction, air port bridge wall blocks and other special shapes. Besides the description of these shapes and dimensions, interesting tables are included in the bulletin as to the number of brick needed, both the common fire brick for different styles of boiler setting and the brick needed for chimney construction. The bulletin can be obtained direct from the company at Baltimore, Md.

FROM THE PENNY ENGINEER, 167 Dearborn Street, Chicago, Ill., comes a novelty in diagrams and tables in the shape of a set of cards the right size for a card index file 3 by 5 in. These are a good stock, hence are durable for handling and filing. The data covered are largely those connected with structural work, including timber, beams, concrete, wire, rivets, plates, screws, flooring and columns. The diagrams are so arranged that the answers to examples can be

conveniently solved without computation. A complete set includes 50 cards and sells for 50 cents.

RECENT BULLETINS ISSUED by the General Electric Co. are as follows:

Folder No. B-3011, describes G. E. Decorative Lighting Outfits for Christmas trees.

In Bulletin No. 4780 is illustrated and described the Gem lamp which has a higher economy and greater illuminating power than the carbon, but is, of course, less efficient than either the Tantalum or Mazda.

Bulletin No. 4781 illustrates the series Mazda lamp, and offers considerable data, proving the advantages possessed by this lamp over the other incandescent lamps used for this purpose. The bulletin illustrates also various styles of fixtures used in connection with street illumination.

Bulletin No. 4777 is an attractive publication on the subject of "Building Lighting," in which many illustrations of both exteriors and interiors of buildings lighted by GE Mazda and Tantalum lamps are shown. In addition to these illustrations, there are data relative to the subject and illustrations of the complete lines of both types of lamp.

TRADE NOTES

REPORTS FROM THE CHERRY CHEMICAL CO., 1018 Callowhill St., Philadelphia, are of excellent business for the month of August and the succeeding fall months. Under the management of Oliver Braden for the past 17 years the success of the concern has been so great that it has been compelled to enlarge its factory to take care of the growing trade, and Mr. Braden has plans for further additions and improvements which will soon be made.

FROM THE CHEMISTS of Germany comes a new packing, the "Wiebelin," which has been produced, taking into consideration the chemical as well as mechanical problems of metallic packing and is intended to have the greatest possible permanency under high pressure and superheat. Contact with heat or liquids in the stuffing-box gives this packing a flexible body, while it is still of metallic character, remaining as elastic as rubber so that it will keep soft and assist in lubrication for years, but cannot possibly score a rod. It will fill every curve in the box and keep a badly used rod tight, yet its chemical properties are such as to withstand the action of gases and liquids for which it is intended, so that even acid, hot oil, brine and ammonia can be handled without leaks. By its peculiar qualities the packing works with an easy cushion effect on the rod or plunger, independent of the gland pressure, thus avoiding the use of the monkey wrench, and this freedom from pressure results in doing away with wear on the rod. The packing is handled in this country by Everybody's Packing Co., Bourse Building, Philadelphia, by whom arrangements are now being made for manufacturing the packing here.

VARIOUS "SWARTWOUT" PRODUCTS, manufactured by The Ohio Blower Co. of Cleveland, Ohio, are having a neck and neck race for the palm of popularity. The score of sales for the last month stood 39 for the Cast-iron Exhaust Heads, 28 for the Centrifugal Separators and 27 for the new Rotary Ball-bearing Ventilators. It hasn't taken the ventilators long to get into the game as they have only been on the market about 3 months. There was a number of repeat orders received and the distribution covered practically the whole United States. Among the largest purchasers may be mentioned Jennings Cotton Mills, Lumberton, N. C.; Summit Thread Co., Easthampton, Conn.; United Supply Co., for Marquette Motor Car Co., Saginaw, Mich.; Michigan Steel Boat Co., Detroit, Mich.; H. J. Heinz Co., North Side, Pittsburg, Pa.; Louisville & Nashville R. R. Co., Howell, Indiana; Jones & Laughlin Steel Co., Pittsburg, Pa.; Western Electric Co., Hawthorne, Ill.; Stone & Webster Engineer'g Corp., Handley, Texas; American Sheet & Tin Plate Co., South Sharon, Pa.

THE FOLLOWING CONCERNS have recently placed exhibits and offices in the Exhibition and Selling Department of the Philadelphia Bourse: Russell E. Baum, Philadelphia, Pa., tag addressing machines; Reading Dyeing & Finishing Mch. Wks., Reading, Pa., hosiery turning machinery; United States Truck & Supply Company, Philadelphia, Pa., trucks, wheels and supplies; The Toledo Wheelbarrow Co., Toledo, O., contractors, tubulars, railroad, stone and garden wheelbarrows; Kermont Incandescent Lamp Co., Philadelphia, Pa., lamps and lamp supplies; Jas. A. Brown, Philadelphia, Pa., pumps, elevators and oil burning apparatus; C. Harper Halfmann, Philadelphia, Pa., office appliances and small tools; Blanton Copper Mining Syndicate, Philadelphia, Pa., mining machinery and minerals; Lancaster Scale Co., Elizabethtown, Pa., scales; Edward M. Hutton, Philadelphia, Pa., marine engines and supplies. Some changes are being made in the department, which makes it attractive, and everything is being done to obtain the best possible results for the exhibitors.

RECENTLY AN AIR COMPRESSOR LUBRICATOR which is a big improvement over previous devices has been placed on the market by the Detroit Lubricator Co. and is so designed that it can be started and stopped without changing feed and pressure adjustments. The adjustment once made stays right, never has to be changed and the oil supply starts and stops with the starting and stopping of the compressor. The opening of a single oil valve starts oil flowing and closing it stops the oil without change of the adjusting valves.

RECENT SHIPMENTS OF THE Wisconsin Engine Co. from the factory at Corliss, Wis., include the following: A 24 and 46 by 42-in. horizontal cross compound, direct-connected Corliss to J. M. Kohler Sons Co., Sheboygan, Wis.; a 32 and 56 by 48-in. tandem compound heavy duty rolling mill engine to the works of the Illinois Steel Co., at Milwaukee, Wis., a 28 by 60-in. heavy duty rolling mill engine and a 30 by 60-in heavy duty Corliss engine to the Girard Iron Co., Girard, Ohio, and a 20 by 42-in. heavy duty Corliss to Jones, Coates & Bailey, of Chicago.

THE ELLIOTT CO., of Pittsburg, Pa., has recently acquired the entire business, patents and good will of the Pittsburg Feed Water Heater Co., Pittsburg, Pa., and will in the future be the sole manufacturer of the Pittsburg Feed-Water Heater, including the 3 types; namely, the vertical, horizontal and closed, and will be able to supply heaters in units from 100 hp. up to and including 30,000 hp.

PARKER BOILER CO., of Philadelphia, just secured orders for the following installations of Parker downflow boilers: Taylor & Co., Alameda, Cal., 2 148-hp. boilers; S. L. Allen & Co., Philadelphia, 1 501-hp. boiler; U. S. Bureau of Mines, Pittsburg, Pa., 1 234-hp. boiler; Farmers Feed Co., New York, 2 330-hp. This is the second order received from The Farmers Feed Co., the first order being for 4 boilers of 275 hp. each, which have been in service since the spring of 1907.

PRACTICAL ENGINEER CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted under regular headings at the rates of 40 cents per line. About nine words make a line. No display type allowed, but the first three words may be set in capital letters. Minimum space sold, two lines.

Under classification, "Positions Wanted," advertisements not exceeding four lines will be inserted for subscribers once free of charge.

To insure proper classification, copy must reach this office on or before the 15th of month preceding publication.

Positions Wanted

POSITION WANTED—By young man, 21 years of age, as fireman, oiler, or any position around a power plant. East preferred. Box 155 Practical Engineer, Chicago, Ill. 11-2

POSITION WANTED—As engineer in a small plant, or as hoisting engineer. Have had several years' experience. Position in South preferred. Address Box 96, Quitman, Miss. 11-2

POSITION WANTED—As engineer by married man, with present central station four years, has Massachusetts license. Would like position in extreme West. A-1 references. Address Box 687, Foxboro, Mass. 12-1

POSITION WANTED—By young man 26 years of age; 8 years' experience. Corliss, slide valve engines, air compressors, and dynamos. Permanent position wanted. Address Box 157 Practical Engineer, Chicago, Ill. 12-1

POSITION WANTED—Engineer with Philadelphia license and 10 years' experience, partly machine shop, can take full charge or act as assistant. Am finishing summer engagement. Address Walter S. Griscom, Dolington, Pa. 11-2

POSITION WANTED—Engineer holding third class Massachusetts license wants position. Good mechanic and electrician with power house and lighting experience. Best of references. D. V. Fox, 385 Moody street, Waltham, Mass. 12-1

POSITION WANTED—By steam and electrical engineer. 30 years of age, married, sober and reliable. Have an A. S. of C. education. Am at present master mechanic for electric railroad. Good references. Address Box 154 Practical Engineer, Chicago, Ill. 11-2

POSITION WANTED—There are dollars to be saved in the boiler room to dimes in the engine room. A chief engineer who understands boiler room economy from A to Z is open for an engagement. Address 158, care Practical Engineer, Chicago, Ill. 12-1

POSITION WANTED—As engineer or assistant in electric power or manufacturing plant by strictly sober young man. Had charge of present Hydro-steam electric plant 27 months, and with steam in previous years. Address Box 156, Practical Engineer, Chicago, Ill. 12-1

Help Wanted

WANTED—AN ENGINEER in each town to sell the best metallic packing for steam, air, gas and ammonia. Write Ideal Metallic Packing Co., South Stillwater, Minn. 5-tf

WANTED—SALESMEN CALLING ON power plant trade to sell Ohio Steam Specialties on commission. High class line, liberal commissions. The Ohio Brass Co., Steam Dept., Mansfield, Ohio. 12-1

WE HAVE a stunning proposition for an engineer in every town or city. Little time required. Will not interfere with regular work. Write for particulars. Address Box 136, Practical Engineer. 8-tf

ENGINEERS AND MECHANICS—To make big money selling Incomparable "ZIZ" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and it will not injure the most delicate skin. Small sample free. Byram Mfg. Co., Box 3133, Boston, Mass. 4-tf

WANTED—THE SERVICES of a representative in Illinois, Indiana and Wisconsin, to look after our old customers and prospective buyers of our Modern Simple Tax-free Industrial Alcohol Distilling Apparatus, by special successful demonstrative methods for making Alcohol, Apple Jack, Aguardiente, Mescal, Teguila, Peach Brandy, Solidified Alcohol in Cubes, Pine Oil, Turpentine, Essential Oil, Etc., also Denatured Alcohol. Most modern simple 5 Gal. Still and all Sizes to 500 Gal. daily Capacities. Good salary and commission. Address with three references. The Wood Waste Distilleries Co., Inc., Wheeling, W. Va., U. S. A. 11-6

Wanted

AGENCIES REQUIRED—AN old established manufacturing firm in London, with a splendid connection among the English and Colonial Railways, is open to make arrangements to manufacture and sell, or to accept an agency for, any really good article likely to be extensively used by railway companies. References would be furnished and required. Communicate to T. N. 310, care T. B. Browne's Advertising Offices, 163 Queen Victoria Street, London, E. C., England. 12-3

For Sale

FOR SALE—ENGINEERS, HOISTERS—LEARN how hoisting engines without the link motion are reversed. Simplified drawing and instructions for 25c. W. A. Jones, 2276 Auburn Ave., Toledo, Ohio. 12-1

FOR SALE—75 H. P. OLDS GAS ENGINE—For natural gas or producer gas; also 80 H. P. Pintsch gas producer; all in perfect condition and will be sold cheap. United Sash and Door Co., Wichita, Kan. 11-2

FOR SALE—THREE RETURN TUBULAR Boilers, manufactured by Ritter Bros., Buffalo, N. Y. Drums 72 in. by 116 ft. Each Boiler with sixty-six 4 inch Tubes. Inspected by Travelers Indemnity Co. of Hartford, Conn. 93 lbs. steam pressure Boilers in good condition. Can be delivered in two or three months, and seen in operation at Buffalo Bolt Company's plant, North Tonawanda, N. Y. 8-6

Patents and Patent Attorneys

FREE BOOKLET—All about patents and their cost. Shepherd & Campbell, Patent Attorneys, 500 M. Victor Bldg., Washington, D. C. 5-tf

HAVE YOU AN IDEAL?—Write for our books. "Why Patents Pay," "100 Mechanicial Movements," Perpetual Motions—50 illustrations. Mailed free. F. Dietrich & Co., Patent Lawyers, 64 Oray Block, Washington, D. C. 4-tf

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 608 F. St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. 10-tf

PATENTS—C. L. Parker, late Examiner U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the inventors. Handbook for inventors sent upon request, 186 McGill Building, Washington, D. C. 4-tf

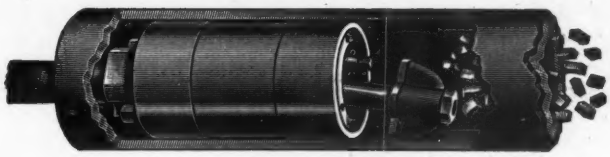
Miscellaneous

EVERY ENGINEER should know about the new system of Vacuum Heating, which can be installed without payment of royalty. Particulars will be cheerfully furnished. T. L. Reeder, 1413 W. Jackson Blvd., Chicago.

Educational

"TELEPHONE TROUBLES" AND HOW to find them, and manual of costs units, New Edition (14th). Price 25c. W. H. Hyde, Telephone Bldg., 183 5th St., Milwaukee, Wis. 12-1

Mr. Engineer, Did You Ever Stop to Consider the Dean?



The Dean Removing Scale from the Tube of a Water Tube Boiler

Really consider—not merely hold some sort of an opinion about it?

Did you ever get our literature and post yourself on the Dean?

Did you ever ask us who is using the Dean, and with what results?

Did you ever get a Dean and try it in one of your boilers?

No? Well, can you **afford** not to?

Lots of engineers have run the Dean through boilers they thought clean—AND FOUND SCALE!

Lots of engineers have got along with three boilers running easy where four, hard pushed, were previously necessary—AFTER USING THE DEAN.

They have made their own work easier and saved money for their employers.

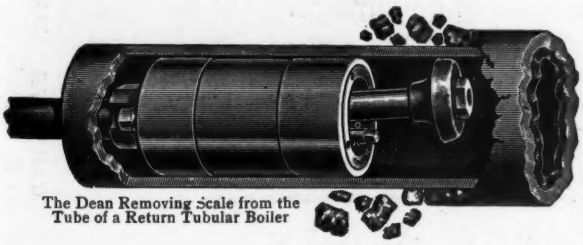
And they have accomplished with the Dean what they could not accomplish with anything else.

Can YOU Afford NOT to Know the

Dean Boiler Tube Cleaner

—the World's Champion Scale Remover?

Operates in Fire Tube or Water Tube boilers—cleans 10 to 30 tubes an hour—driven by air or steam—guaranteed to save its cost in six months' time.



The Dean Removing Scale from the Tube of a Return Tubular Boiler

You can find out what the Dean will do **before** purchasing it—right in your own boiler room.

You can get one of our Deans and clean one boiler—free of charge.

Then you can watch your coal pile and your steaming for a while.

If you don't see any improvement in the steaming, any decrease in your fuel consumption, return the cleaner at our expense.

Suppose you write for a Dean **today**—impossible to make a mistake.

The Wm. B. Pierce Co.

29 Washington Street **Buffalo, N. Y.**

MARCO MARCO MARCO MARCO MARCO MARCO MARCO MARCO
PACKING PACKING PACKING PACKING PACKING PACKING PACKING

AMMONIA is said to be healthy for the lungs but ammonia in an engine room is bad for the disposition of the engineer and has a peculiar effect on the boss. He never likes to smell ammonia. There are forty eleven hundred kinds of ammonia packings. Every man has his own ideas. Some use a sectional ring and a standard ring alternating; some use a diagonal; some use a gum ring. Whatever you use, you must not forget that it's as necessary to keep your hand on the gland as on the expansion valve. You may regulate the temperature of your cylinder with the expansion valve. When your cylinder gets hot, your packing gets hot. When your packing gets hot it swells. Then you've got to slack off on your gland. If you don't, your packing will bind. On the other hand, when the cylinder gets cold your packing contracts, and if you don't run the gland in, your packing will allow ammonia to escape. It keeps a fellow watching that gland. If the packing gets hot, it may burn. If it gets too cold, ammonia will leak.

Whatever packing you want, you can be sure of getting the best goods if you use MARCO packings. They have compounds especially prepared to withstand ammonia. They have rubber rings that have run from two to three years on the same stuffing box. They have a diagonal which will work longer than any other. Their packings for ammonia are all arranged for a quick adjustment. Drop a line to them and they'll write you about it and give you other kinks that might be of advantage.

So long,

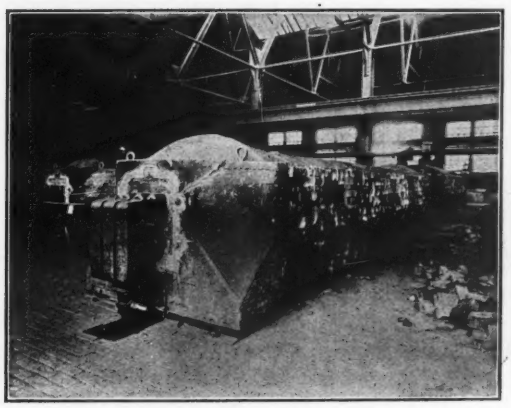
M. ARCO.

IL2

THE CLEVELAND RUBBER WORKS
OF THE MECHANICAL RUBBER CO.,
74 LISBON ROAD,
CLEVELAND, OHIO.

PACKING PACKING PACKING PACKING PACKING PACKING PACKING
MARCO MARCO MARCO MARCO MARCO MARCO MARCO MARCO

MADE FRESH EVERY DAY



One of the Electric Furnaces in which gritless Acheson-Graphite is made at a temperature over 7,500° F., the highest temperature used on earth.

What a different impression this gives you of Acheson-Graphite as compared with natural graphite that is mined after being buried in the earth for centuries.

It should tell you that ***Acheson-Graphite is a modern product for modern use on modern machinery.*** Blended with a high grade grease in the form of

GREDAG

REG. U. S. PAT. OFF.

it makes a Combination Lubricant that is unequalled. The unctuous, soft, pure graphite imparts a veneer or film that will not break under pressure as will a film of oil or grease alone. It affords lubrication that is lasting, safe and economical.

GREDAG will do more to reduce friction and prevent wear of the parts than any other lubricant. It is the only grease that contains Practically Chemically Pure Acheson-Graphite—***the only graphite suitable for lubrication.***

SEND FOR A SAMPLE. TEST IT. LET IT PROVE ITS MERIT. ASK FOR FOLDER 383 D.

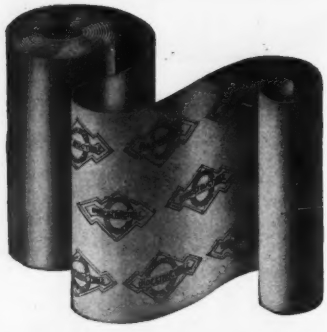
INTERNATIONAL ACHESON GRAPHITE COMPANY

NIAGARA FALLS, N. Y.

New York Branch, Room 511, West Street Building.
Chicago Branch, 457 Monadnock Block.
Pittsburg Branch, 311 Penn Building.
Southern Branch, Atlanta, Ga.
Fred Ward & Son, San Francisco, Cal.
Crosier, Stephens & Co., 2 Collingwood Street, Newcastle-on-Tyne, England.
Georg A. Anthony, Dovenhof 120, Hamburg 8, Germany.

Three Thriving Triplets

COBBS HIGH PRESSURE SPIRAL PISTON AND VALVE ROD PACKING



INDESTRUCTIBLE WHITE SHEET PACKING

1846 PARA RUBBER BELT

You can make no mistake in ordering these goods of known quality and unblemished reputation. They have stood the test of keenest competition for years and are far in the lead for quality of raw material and careful manufacture.

We have Catalogs and Booklets with just the kind of information you require. Tell us the line of mechanical rubber goods you are interested in and we'll send you personally the booklet that tells all about that line. Drop us a card now while you're thinking about it.

BRANCHES
CHICAGO, ILL. 150 LAKE ST
ST. LOUIS, MO. 218-220 CHESTNUT ST
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SAN FRANCISCO, CAL. 129-131 FIRST ST.
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NEW YORK BELTING & PACKING CO. LTD.

91-93 CHAMBERS STREET
NEW YORK

BRANCHES
PORTLAND, ORE 40 FIRST ST.
PITTSBURGH, PA. 913-915 LIBERTY AVE.
SPOKANE, WASH. 163 S. LINCOLN ST.
INDIANAPOLIS, IND. 229 S. MERIDIAN ST.

The Rollo Tales—No. 2

"Our teacher must lie awake nights thinking up hard stunts for us to do!" said Rollo.

"What is the latest spasm?" demanded his Father.

"She wants me to calculate just how many miles the Engineer walks every day as he goes about his shop oiling his machinery."

"That looks like a hard one!" replied his Father.

"I'll get it on the way to school," said Rollo.

That night his Father asked him if he had solved the problem, and Rollo replied, "It was easy. I just asked the Engineer!"

"And what was the answer?" inquired his Father, smiling.

"Well," began Rollo, "it was like this. I watched the Engineer for a long time and he never moved. It seemed to me that he had an Easy Job. By and by I went in and told him what the teacher wanted. He just laughed. Then he said:

"Kiddo, your teacher wants to wake up. The Engineer now gets exercise playing golf, not in walking round oiling up. The Fellow who uses oil as a Lubricant is a Back Number who is not on to his job."

"Shall I tell my teacher that?" I asked.

"Tell her that nowadays the wise Engineer uses **KEYSTONE GREASE** instead of oil," said he. "I would suggest that she give you some newer problems to solve. One like this, for instance:

"If one pound of **KEYSTONE GREASE** outdoes and outlasts four gallons of any known oil, what is the saving in labor alone in any known instance?"

"I'll hand that to her!" said I, and then the Engineer added.

"You just tell her that **KEYSTONE GREASE** is pushing oil off the Earth. It never spatters, drips, runs or melts because its consistency, as well as its efficiency, is constant in all temperatures. It contains no fats, resins, or graphite or mica, being a pure mineral grease. Its potential lubricating effectiveness is materially buttressed by the fact that its use results in a material saving in labor, fuel, power, repair, cleanlng and insurance bills."

"What did your Teacher say?" inquired Rollo's Father.

"She laughed and said she had heard of **KEYSTONE GREASE** before."

EVERY ENGINEER KNOWS THE ANSWER.

We will ship you a barrel of KEYSTONE GREASEon 90 days' time from date of shipment. If results prove unsatisfactory the unusued portion may be returned and no charge will be made for the quantity used. Eight (8) brass grease cups will be sent free of charge with first purchase of barrel.

A large stock of KEYSTONE GREASE is always on hand at our various warehouses, named below. Prompt shipment can be relied upon.

KEYSTONE LUBRICATING COMPANY

Department F **PHILADELPHIA, PA.**

Main New England Office and Warehouse—
284-290 Franklin Street, Boston, Mass.
Northwestern Agent and Warehouse—
Century Building, Denver, Colo.
Main Southern Office and Warehouse—
610 Chartres Street, New Orleans, La.

Main Pacific Coast Office and Warehouse—
268 Market Street, San Francisco, Cal.
Chicago Office—
2123 Michigan Avenue.
New York City Office—
1777 Broadway.

NO CONNECTION WITH THE OIL TRUST.

How to Get the Hand-book, FREE

Fill out the Coupon, and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you FREE of charge when you call at his store and *look* at Daniel's P. P. P. Packing.

Your Name.....
Address .....
Employed by .....
Horsepower of Engine.....
Kind of Packing Used.....
Dealer's Name .....
Address .....
.....

Series 11-L

If your dealer doesn't carry P. P. P. we will write telling you who does, and the book will be sent to the dealer we name.

Please do not call for book until we notify you.

"Boys, Here's the FREE Engineering Book"

In a power plant nothing creates more interest than this book of "Questions and Answers to Engineers' License Examinations." We want **you** to have one for the help it will give in passing your License Examination.

To secure one of these books **absolutely** FREE, all you need do is to fill out and mail the coupon, then go to your dealer's and **look** at

Daniel's P. P. P. Rod Packing

"Regular"

Advantages of Daniel's P. P. P. Packing

By its use is obtained the **minimum** amount of **friction,** and the **maximum** amount of **wear.** It is self-lubricating to a great extent. It will **not** become hard. It works equally well on heavy mining pumps and the most sensitive valve stems. It is a perfect preventive against loss of ammonia in ice machines.

Three Styles: "Regular," "Special," and "Marine." All styles are furnished in Coil, Spiral, and Ring forms.

If You Use P. P. P.

If you are already a user of Daniel's P. P. P., fill out the coupon, and write the words: "Valve Grinders" on the blank line. You will get the FREE Book when you call at your dealer's and **look** at (not buy) a set of

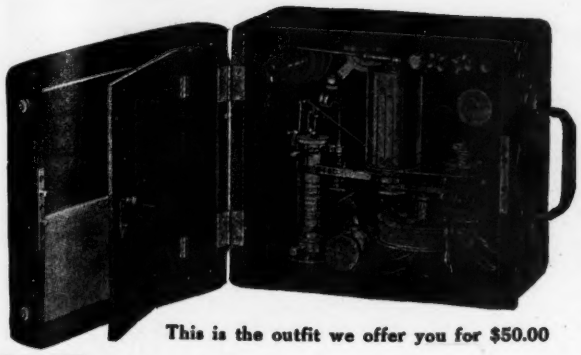
Daniel's Graded Valve Grinders

These Grinders reseat valves of every style and size. They save time, trouble and money.

The "boss" will order a set if you tell him how they'll save his pocketbook.

QUAKER CITY RUBBER COMPANY

PHILADELPHIA CHICAGO PITTSBURG NEW YORK



This is the outfit we offer you for $50.00

Be on the Same Level

$5 Brings you a **Robertson-Thompson Indicator** and **A Victor Reducing Wheel** with complete attachment down to the smallest detail.

You want to be at least on the same level with any man in your profession, don't you?

All the same, you know well enough that the engineer who owns and uses an indicator is considered more capable than the engineer without one—and you must admit that he can do things that the other cannot do.

Remember, buying an indicator is simply something you must do to bring yourself up to the level where you ought to be.

It's merely a question of benefiting yourself. Don't put it off. You cannot buy better made, more perfect service giving, more high grade instruments than a ROBERTSON THOMPSON INDICATOR and VICTOR-REDUCING WHEEL. Hundreds of engineers will back up what we say. And think of it we sell these instruments and all that goes with them on easy terms. $5.00 down and $5.00 a month.

We guarantee the outfit in every particular and give you five days to EXAMINE it. If not up to your expectations send it back at our expense and we will return your $5.00.

As a special year end offer—good until January 1, 1911.

On the handsome hardwood Indicator case we will place a sterling silver plate with the buyer's name and address engraved upon it, if so requested.

Engineers' Log Book—FREE

We are sending this free to all engineers who are interested in our indicator offer. This "Log" makes it easy to keep records—fuel and oil used, when engine was started and stopped, loads carried, etc., etc.—there's a place for everything you want to keep track of. Just fill out and mail us the coupon and we'll send you a copy absolutely free.

This is the BIG OFFER and Price

The COMPLETE Robertson-Thompson Outfit—Indicator and Reducing Wheel—packed in handsome hardwood case, with lock and key and nickel-plated trimmings, and fitted with extra ¼ inch area piston, detent motion, two springs as selected, either one 3-way or two straightway cocks, scales, cards, oiler, cord, book of instruction, etc., exactly as shown above.

Price $50—$5 down and $5 a month

One price for the whole thing, no extras. A complete indicating outfit at the price you can afford to pay. Send us a few reliable references. SEND IN THE COUPON TODAY ☞

THE WILLIS PLANIMETER
Price $12.50—$2.50 down and $1.25 per month

JAS. L. ROBERTSON & SONS
74-76 Murray Street, New York

Pract. Eng. No. 7.

Send me Log Book and full details of the Robertson-Thompson Indicating offer.

Name .....

Address .....

Engineer for .....

MAKE GOOD

That's what we all must do. Yet there are mighty few of us who can make good unaided, and not one of us can afford to overlook the little things that help us to make good.

In your case as an illustration, take Packing; it's a little thing in a way, yet you know what big results come from it. Helpful or harmful, friction, lost power, cut rods, etc., all depending on the kind.

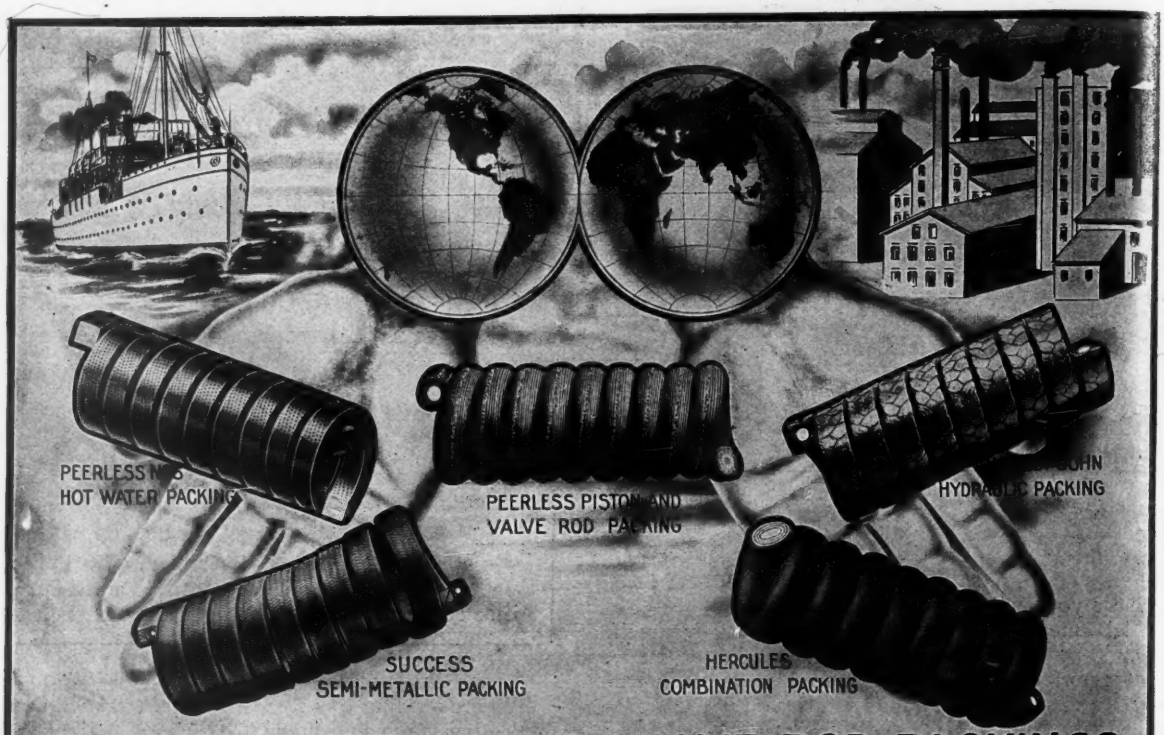
Packing deserves your studied attention, and the time it deserves it is when you buy. Study the principle of construction, the kind and quality of material and the way they are put together.

For any steam pressure up to 125 lbs. you can't buy or no one can give you a packing that will do more service or longer service, or that will keep your engine and pump rods in better condition than **Genuine Eureka Gum Core Packing.** The flax covered, rubber cored anti-friction packing.

It is the one packing, making good when others fail—only be sure to get the genuine Eureka.

EUREKA PACKING COMPANY, Sales Department

JAMES L. ROBERTSON, President **Sales Dept. 74-76 Murray Street, New York City**



THE BEST PISTON AND VALVE ROD PACKINGS
THE WORLD HAS TO OFFER FOR USE ON LAND AND WATER ARE
PEERLESS PISTON AND VALVE ROD PACKING,
HONEST JOHN HYDRAULIC PACKING,- PEERLESS No 6 HOT WATER PACKING,
SUCCESS SEMI-METALLIC PACKING,- HERCULES COMBINATION PACKING,
THEY ARE MANUFACTURED FROM THE HIGHEST GRADE MATERIALS BY THE CORRECT PROCESS - IN THE SIMPLEST FORM - DO THEIR WORK PERFECTLY AND GIVE THE LONGEST SERVICE. THIS IS WHY THE PEERLESS LINE IS THE STANDARD OF THE WORLD. HAVE BEEN USED BY PROMINENT ENGINEERS FOR YEARS WITH BEST RESULTS. LET THE OTHER FELLOW DO THE EXPERIMENTING.

MANUFACTURED SOLELY BY

THE PEERLESS RUBBER MANUFACTURING COMPANY

16 WARREN ST., NEW YORK

DETROIT, MICH.-16-24 WOODWARD AVE.
CHICAGO, ILL.- 200-208 SO. WATER ST.
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ATLANTA, GA.-64-70 MARIETTA ST.
SALT LAKE CITY, UTAH: 45-52 W. 2ND SOUTH ST.
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SEATTLE, WASH.-FIRST & KING STREETS
CHATTANOOGA, TENN.-1100-1120 MARKET ST.
INDIANAPOLIS, IND.-38-42 SO. CAPITOL AVE.
DENVER, COL.-1556 WAZEE STREET.
HELENA, MONT.-113-117 MAIN ST.
PORTLAND, ORE.-69-75 N. 12TH ST.
PHILADELPHIA, PA.-19 NORTH SEVENTH ST.
BOSTON, MASS.-110 FEDERAL ST.
BUFFALO, N.Y.-379-383 WASHINGTON ST.
ROCHESTER, N.Y.-24 EXCHANGE ST.
SYRACUSE, N.Y.-212-214 SO. CLINTON ST.
LOS ANGELES, CAL.-359 NORTH MAIN ST.
ST. LOUIS, MO.-454 PIERCE B'L'D'G
BALTIMORE, MD.-37 HOPKINS PLACE
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LONDON E. C., ENGLAND.-11 QUEEN VICTORIA ST.
PARIS FRANCE.-76 AVE. DE LA REPUBLIQUE
VANCOUVER, B. C.- CARRAL & ALLEXANDER STS.
COPENHAGEN, DEN.- FREDERIKSHOLMS KANAL 6
JOHANNESBURG, SOUTH AFRICA.-BARSDORF B'L'D'G.
PEERLESS RUBBER SELLING CO. OF AUSTRALASIA, LTD. 1 ASH STREET, SYDNEY AUSTRALIA.

FIRST PRIZE

TO THE ENGINEER WHO SENDS FOR DETAILS OF THIS FREE PRIZE CONTEST WE WILL SEND FREE ONE OF THESE 10,000 PACKING KNIVES

SECOND PRIZE

A $375.00 — 1910 Model

Indian Motocycle

Two Cylinder — 5 H. P.

Stop a minute and think how convenient a motorcyle would be to you. It will save lots of time going to and from work and take you from your front door right to the engine room door.

Besides, on Saturdays and holidays you can take long rides over the country, enjoy the healthiest kind of recreation and get the keenest sort of pleasure from the sport.

Now the Indian is about the neatest thing in motorcycle construction you could imagine. You know the reputation it has.

BETTER SIGN THE COUPON

This is as complete a set of tools as any engineer would want. It is worth $150.00 and includes a $65.00 Tabor Indicator which does not show in the picture.

READ OVER THE LIST

1 Tabor Indicator, complete with 1 spring and scale.
7 Coes Wrenches 6, 8, 10, 12, 15, 18, 21 inch
6 Stillson Wrenches 6, 8, 10, 14, 18, 24 inch
4 Double End Finished Wrenches, ¼x⅜ in., ½x⅝ in., ¾x⅞ in., 1x1¼ in.
3 pr. Inside Calipers 4 in., 8 in., 12 in.
1 set Packing Tools.
1 6 in. Screw Driver.
1 12 in. Steel Scale.
1 2 ft. Boxwood Rule.
3 pr. Outside Calipers 4 in., 8 in., 12 in.
3 Ball Pene Hammers, No. O., No. 1, No. 2.
1 set Armstrong Dies, ¼ in. to 1 in., with Taps.
1 2 ft. Carpenter's Square.
1 50 ft. Metallic Tape Line.
1 Hack Saw Frame with 1 doz. 12 in. Blades.
1 Gauge Glass Cutter.
1 6 in. Steel Square.
1 set Cold Chisels.
1 Speed Indicator.
1 Thread Gauge.
1 Centre Gauge.
1 Centre Punch.
1 Tool Chest.
1 Hand Saw.

DON'T FORGET THE COUPON

Third Prize
$75.00 Elgin Gold Watch

Fourth Prize
$50.00 in Gold

SIGN THE COUPON NOW

Fifth Prize
$25.00 in Gold

Sixth Prize
$10.00 in Gold

This is the most valuable prize contest ever offered to engineers, and whether you try for one or more of the prizes or not, everyone receives a free knife.

But, aside from all these valuable prizes the real value that everyone can obtain from this proposition is the packing itself.

It is only because SOLAROID (Red Sheet) and BLACKOID (Black Sheet) Packings themselves are so far ahead of the sheet packings now on the market that we can afford to make such a valuable offer as we have above.

These may be new packings to you, but as a matter of fact they've been in successful use for years, and the comparatively few engineers who have been using them up to this time are unanimous in their endorsements, for we've been improving them year in and year out in order to reach the present stage, where we can state that they will stand more service than any other and be dead sure they will live up to the statement.

But—claims are usually so exaggerated that we do not believe much in them.

What we want is for you to put either of these packings right to work on the hardest job you can think of—put them right beside sheet packing you're now using, and watch the difference.

Now, there's more information about the packings which we'll send when you send in this coupon.

So send in the coupon now for the knife, free samples, details of the prize, contest and booklet "How to Cut Gaskets." After you send the coupon ask your dealer about the packing.

But send the coupon before you forget.

NOTICE

The replies to this offer have been so enormous that if you should send in a request for a knife, etc., and you do not receive it immediately do not get worried—you'll get it promptly, but in spite of the great effort we are making, requests are coming so rapidly as to necessitate some little delay. If, however, you do not receive your knife within a reasonable time please advise us at once.

Thermoid Rubber Co.

Trenton, N. J.

COUPON

GENTLEMEN: I should like to have your booklet, "How to Cut Gaskets," and one of your Knives for cutting sheet packing; also further information concerning this contest to secure the articles advertised in the Practical Engineer, issue of December.

Name.....
Home address.....
Firm employed by.....
Firm address.....
Dealer's name.....
Dealer's address.....
Kind of sheet packing used.....
Average amount used each year.....

$50.00 Reward!

Worthless Imitations of the Celebrated

Vanda Packing

VANDA
A STEAM PACKING THAT IS A STEAM PACKING
TRADE MARK
(REG. IN U.S. PATENT OFF.)

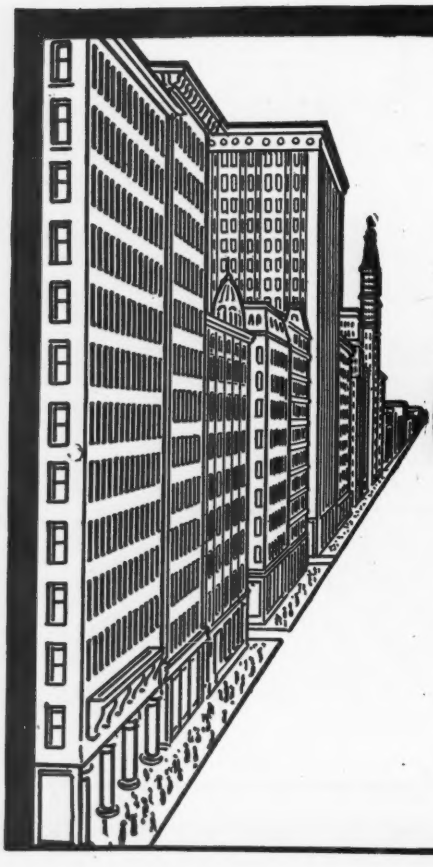
VANDA Packing is sold by dealers everywhere. Distributing Agents in all large cities.

are being offered for sale by unscrupulous manufacturers, jobbers, dealers, etc., as being the genuine VANDA. These imitators who have no originality, nor the ability to invent anything themselves, exist only to try and imitate or copy some article of commerce of known merit and reputation—such as Vanda Packing—regardless of the dangerous consequences to engineers and others who are defrauded by their spurious goods. They also permit their salesmen, agents, etc., to make misrepresentations as to the relative merit of these imitations compared with the original Vanda goods.

VANDA PACKING is the original fibre sheet packing—the genuine is stamped with the above registered trade-mark on every sheet—none is genuine without it.

TO ANY ENGINEER who can furnish us with information or evidence sufficient to lead to the successful prosecution of these imitators, the above mentioned reward will be paid.

The Vanda Co.
96 Spring Street,
NEW YORK CITY



PERFECTED HOSE,
RAINBOW BELT,
Rainbow, Peerless, Eclipse,
PACKING.

GEO·B·CARPENTER & CO.

WESTERN STORE:

Peerless Rubber Mfg. Co.
202-210 SOUTH WATER STREET

CHICAGO

You get quick service from either our Chicago or Denver stores.

You Can Do the Very Thing—This Man Did

¶ Send for a sample McKIM Gasket free of charge and try it on your most troublesome joint.

Resilient Packing Bound With Soft Ductile Copper

Adrian, Mich., Oct. 20, 1910.

The McCord Mfg. Co.

Gentlemen: In answer to your letter of the 7th regarding Sample Gasket, I beg to state that I put it in the worst place I had, steam line to feed pump, pressure off and on about steen hundred times a day, and it is simply fine. No bother whatever. When we overhaul in January, will give you an order to equip entire plant.

Our season will last till about January 1st and, weather permitting, we will overhaul and install new equipment.

Yours respectfully,

H. M. ROWLEY,
Acme Preserve Co. Adrian, Mich.

The Strength of Metal and the Elasticity of Packing

¶ You will find that this Gasket will not only hold the joint tight, but it can be reapplied many times, still giving excellent results. This is *real economy.*

¶ Let us send you a booklet telling you more about McKIM GASKETS.

¶ Drop us a note before it slips your mind.

McCord Manufacturing Company

Chicago DETROIT New York

If YOU don't know the lasting qualities of

Twist
Sizes—⅛. ⅜. ¼ inch

"PALMETTO"
REG. TRADE MARK
PACKING

under steam and air pressures, send at once for Free working samples; they will convince you.

GREENE, TWEED & CO.
Sole Manufacturers
109 Duane St., NEW YORK

Braided. Round and Square
From ¼ inch up

A Sure Way to Reduce Coal Bills

If the pipes of your steam plant are covered with only an ordinary covering, or not covered at all, you are wasting hundreds, perhaps thousands, of dollars every year. Repeated tests have proven that when pipes are not properly insulated, from one-quarter to three-quarters of the fuel burned is wasted by radiation and condensation.

J-M Asbesto-Sponge Felted
Pipe Covering

positively prevents radiation and condensation. It carries steam a mile with practically no loss. It is the most efficient covering on the market, because it confines the greatest amount of dead air—the secret of insulation.

J-M Asbesto-Sponge Felted is also the most indestructible covering on the market. It will not crack, break or lose its insulating value from vibration or rough usage.

Write nearest branch today for Catalog No. 100, or send us your address on the margin of this advertisement.

H. W. JOHNS-MANVILLE CO.

Manufacturers of Asbestos and Magnesia Products. ASBESTOS Asbestos Roofings, Packings, Electrical Supplies, Etc.

Baltimore Buffalo Cleveland Detroit London Milwaukee New Orleans Philadelphia San Francisco St. Louis
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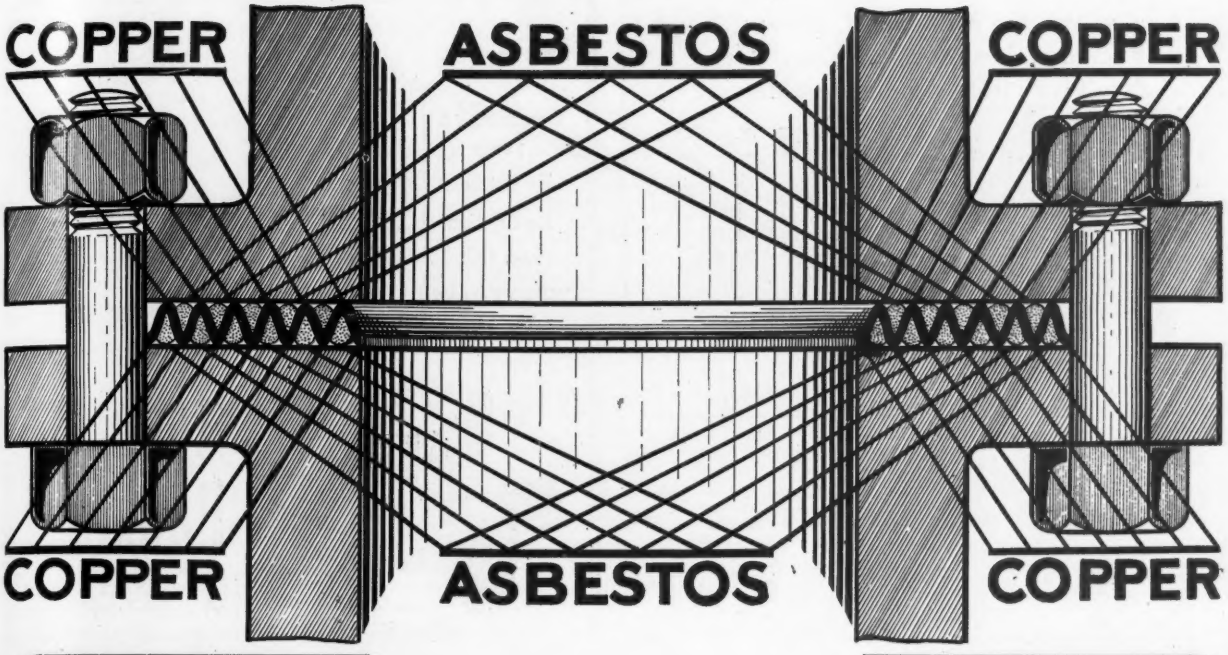
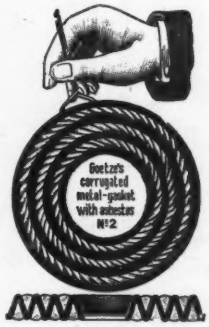


You Can See Why Nothing Gets by Goetze's Elastic Corrugated Copper Gaskets

with Asbestos Lining No. 2—why we can and do **guarantee** them to make **permanently** tight joints against the **highest** of pressures or temperatures—even **highly superheated steam**—and in **long lines.**

Those alternate walls of chemically pure copper and best asbestos do the business.

You can see what happens when you take a few turns on your flange bolts. You set **each** copper corrugation **snugly** against the flange surface and, at the same time, crowd **each** wall of asbestos against the same surface.



And you get the same action on both flanges at the same time, for Goetze's No. 2 Gaskets are **exactly alike on both sides**—a wall of copper, then a wall of asbestos—of each.

But you don't have to accept the evidence of a picture—you needn't even take the word of users whose testimonials we have printed by the dozen in previous issues of this paper.

We'll Send You a Supply of Goetze's No. 2 Gaskets For 90 Days' Trial, Entirely at Our Risk and Expense

and give you ample opportunity to find out what they will do for **you,** right under your own roof.

That's the test that tells, and we offer it without conditions. If Goetze's No. 2 Gaskets don't make good in every particular, we don't want a cent of your money.

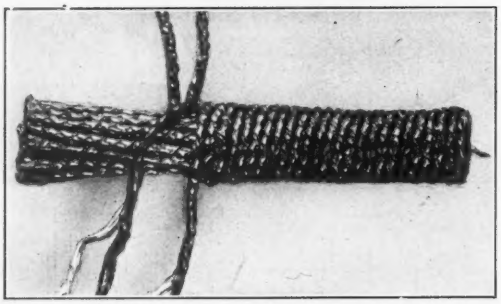
In fact, we invite you to **make them fail if you can.**

If you know any other copper gaskets that you think are in the same class, **get them and try them out at the same time, in the same service.**

But don't think for a minute that we make copper pipe gaskets only. We've a **complete line** of Packings for All Power Plant Purposes, including Goetze's Copper Valve Gaskets for valves of Jenkins and similar types (which we also send on 90 days' trial), and they're all shown in their natural colors in our New Catalog—yours in exchange for your name and address.

AMERICAN GOETZE-GASKET & PACKING CO., - New Brunswick, N. J.

You've Put Up with Short-Lived Fibrous Packings Just Because They Were Flexible and Compressible



Federalite ready to be pressed into square mold—note how the shreds of metal are twisted around the string of asbestos, hemp or flax.

You knew you had to have a **flexible** packing but you probably didn't know that you could get the **flexibility** of a fibrous packing combined with the **greater durability** of a metallic packing.

And, as a matter of fact, you couldn't until FEDERALITE FLEXIBLE, COMPRESSIBLE, METALLIC PACKING was born in the fertile brain of a practical man who had been studying for years to produce what you wanted. "Federalite" is **flexible.** It has all the flexibility you need and from five to twenty times the life of the best fibrous packings. We're so sure of this that we **guarantee** "Federalite" to give from one to three years of satisfactory service, or money refunded, providing the rod is true and in line when "Federalite" is applied.

And this means under any pressure or any degree of heat up to 650, in service with steam, ammonia, water, oil, air, or brine.

Try it for 30 days at **our** risk. After that time our guarantee takes effect.

Federal Metallic Packing Co., Boston, Mass.

First cost, only cost.

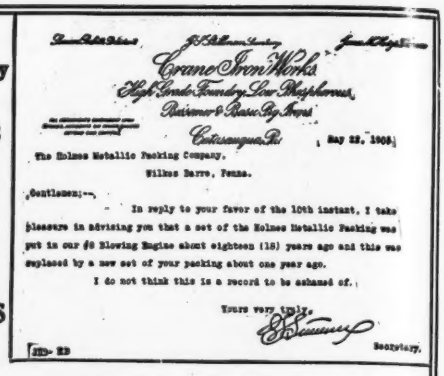
Guaranteed 3 years

No Cutting.

No Friction

Less Oil.

THIRTY DAYS TRIAL.



Crane Iron Works
High Grade Foundry Low Pressure
Reducing & Reducing Valves
Chicago, Ill. May 23, 1908.

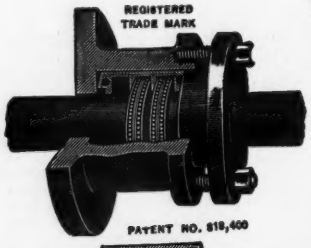
The Holmes Metallic Packing Company,
Wilkes Barre, Penna.

Gentlemen:—

In reply to your favor of the 10th instant, I take pleasure in advising you that a set of the Holmes Metallic Packing was put in our 8 Blowing Engine about eighteen (18) years ago and this was replaced by a new set of your packing about one year ago.

I do not think this is a record to be ashamed of.

Yours very truly,
Secretary.



PATENT NO. 818,400

PAT. NO. 488,177 · " " 500,899 · " " 584,104 · " " 602,828

PAT. NO. 664,841 · " " 664,842 · " " 726,880 · " " 775,198 · " " 775,199

Holmes Packing

is now recognized as being superior to all others, and is a common name among engineers.

Send for Catalog H.

Holmes Metallic Packing Co., Wilkes Barre, Pa.

"SAFETY" PLASTIC METALLIC PACKING

For Steam, Water, Air, Gas, Hydraulic Machines, Valves, Etc.

Guaranteed to stand Steam Temperature up to 550° F. and Hydraulic Pressure to 5000 lbs. per square inch.

Highest Award World's Fair St. Louis.

Send for **FREE SAMPLE** and particulars.

MANUFACTURED BY

STEEL MILL PACKING CO., Detroit, Mich., U.S.A.

Chicago Warehouse, 223 N. Jefferson St.

NEW IDEA

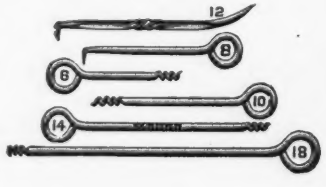
This is what you have been looking for. A Sure Cure for YOUR Pump Troubles.

Mail us your pump conditions and we furnish the right valve. . . Twenty years experience.

THE CORTAY PACKING CO.,
143 WARREN ST. TRENTON, N. J.

This Set of (6) Mound Packing Tools Belongs in Your Kit—

and you can't afford to be without it on the liberal terms we offer.



SEND THIS COUPON

MOUND TOOL & SCRAPER CO.,
Seventh and Hickory Streets, St. Louis, Mo.

Gentlemen: Enclosed find One ($1.00) Dollar, for which send me one set of (6) Mound Nickel-plated Packing Tools, price $2.25, and I hereby agree to remit balance, One Dollar and Twenty-five Cents ($1.25), within sixty days.

NAME .....

ADDRESS .....

EMPIRE

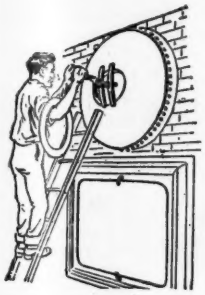
The original GUM CORE Braided

PACKING

The late Wm. M. Canfield was the originator of Gum Core Braided Packings. That was 45 years ago, and ever since that time Empire has been the standard.

Ask your dealer for Empire, see that the label is as shown in cut.

Canfield Mfg. Co.,
The oldest Gum Core Braided Packing Mfg'r's. in the U. S.
Philadelphia, Pa.



J-M Permanite Sheet Packing Best For Every Purpose

J-M Permanite is the best Packing, because it is made of the highest grade long-fibred Asbestos, to which are added compounds which give it all the pliability of a rubber packing. Actual service tests have shown that J-M Permanite will last three times as long as the ordinary sheet packing.

Best Resists All Pressures

J-M Permanite Packing has no equal for use on high or low pressures, superheated steam in cylinders, steam chests, steam and ammonia lines, acids, alkalies, and sugar solutions. It will pack permanently tight any joint, rough or smooth. There will be no blowing, burning or squeezing out and it requires no following up.

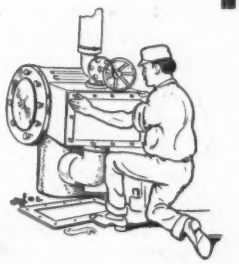
Write nearest branch today for Samples and Booklet, or send us your name and address on margin of this advertisement.

H. W. JOHNS-MANVILLE CO.

Manufacturers of Asbestos and Magnesia Products — ASBESTOS — Asbestos Roofings, Packings Electrical Supplies, Etc.

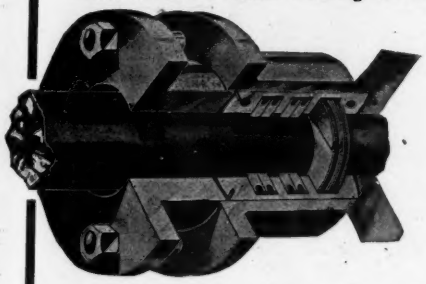
Baltimore, Boston, Buffalo, Chicago, Cleveland, Dallas, Detroit, Kansas City, London, Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburg, San Francisco, Seattle, St. Louis (1233)

For Canada: THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED. Toronto, Ont. Montreal, Que. Winnipeg, Man. Vancouver, B. C.



A Few Points of Difference

between France Metal Packing and the others



The material and workmanship is the best possible.

The packing is of few parts—it is easy to apply

The rings are made of cast iron or bronze according to service.

It will hold any pressure, any temperature, any speed. It will pack ***steam, air, gas*** and ***ammonia.*** France does not pack liquids.

It is ***made to last*** as long as any other wearing parts of the engine—***six to twelve years.***

It is ***guaranteed satisfactory*** or we expect ***no pay.***

IN THE OTHERS

Well put this in your pocket and make ***comparison*** for ***yourself.***

When you are through compare prices and value and see which you want.

IT'S UP TO YOU!

THE FRANCE PACKING COMPANY

PHILADELPHIA, :: PENNA.

Will you send for catalog?

The New Huhn Packing Book

It's a "catalog," for want of a better descriptive term, but you'll miss the dryness of the conventional trade-isms, and be struck with the frankness, clearness and vigor with which it gets down to business. No preface, or preamble. Straight talk, clean hard facts, in plain business English, from start to finish.

Written by a man who knows his business—with the assumption that YOU know your business—and it does not insult your intelligence by the presentation of claims which you know cannot be true.

Deals in definite facts—known quantities. Tells precisely what you may expect from HUHN Metallic Packing, and shows you in thirty or more of the finest reproductions ever made for the purpose, the different ways in which you can use HUHN to advantage in your own plant.

Your address on a postal (make it out carefully, name, plant, position, and all—so that we can't make any mistake in addressing) will be sufficient. And your copy will leave by the next mail, ready for you to read and digest.

"FOR FOURTEEN YEARS, A PACKING STANDARD."

AMERICAN HUHN PACKING CO.

410-416 EAST 32nd STREET, NEW YORK CITY

The latest discoveries in Mechanics and Chemistry are embodied in

Plastic–Elastic–Metallic Permanent Packing

WIEBELIN

THE IDEAL PACKING "EVERYBODY" HAS BEEN LOOKING FOR

Put in every stuffing-box like a putty.

WILL LAST FOR YEARS ON STEAM, HOT OR COLD WATER, GAS, OIL, ACIDS AND AMMONIA
ABSOLUTELY NO WASTE NO FRICTION NO DIFFERENT SIZES

Self Lubricating
The saving in Oil pays for the Packing

The Remedy for Scored Rods

Easy to Pack
Easily Removed
Never Hardens

A FEW OF OUR TESTIMONIALS

Philadelphia, Oct. 11, 1910.
Everybody's Packing Co., Philadelphia.

Gentlemen:—Referring to your favor of the 4th inst., would advise that the packing in question was placed on one of our air compressors on March 5th of this year, and it is still giving satisfactory service.

Yours very truly,

Baldwin Locomotive Works, E. P. Williams, Purchasing Agent.

Camden, N. J.,
March, 22nd, 1910.

To Everybody's Packing Co., Bourse Building, Philadelphia, Pa.

Gentlemen: I am pleased to inform you that the Gas Compressor which you have packed on the 7th of February with your Plastic-Elastic Metallic Packing "WIEBELIN" has given us entire satisfaction. The Packing is holding the Compressor perfectly tight, notwithstanding the rod being very badly scored on account of poor packing used in it before. I did not have to tighten up but once since the packing was put in, the machine seems to be running practically without friction and the rod never gets heated. I can certainly recommend this packing for similar service and remain.

Yours very truly,

The Pintsch Compressing Co., Ira Hulse, Superintendent.

DIOGENES SHEET

A FEW OF OUR TESTIMONIALS

Camden, N. J.,
Nov. 1st, 1910.

To Everybody's Packing Co., Bourse Building, Philadelphia, Pa.

Gentlemen: Confirming our testimonial of March 22nd we wish to inform you that your Plastic-Elastic-Metallic Packing is still holding out fine. In July last we took it out for inspection and found it without the least signs of deterioration. After kneading it over with some fresh "WIEBELIN" we put the same Packing back in our Gas Compressor where it continues to give entire satisfaction

Yours very truly,

Pintsch Compressing Co., Ira Hulse, Superintendent.

Philadelphia, Pa.,
Oct. 1st, 1910.

To Everybody's Packing Co., Bourse Building, Philadelphia, Pa.

Gentlemen:—I take pleasure in stating that the twelve hundred pound Steam Hammer which was packed by you on the 9th of October, 1909, with your Elastic-Metallic Packing has been in constant use ever since and is still doing excellent service with the same set of Packing. I consider your Packing the best on the market for the exacting duties of Steam Hammers and can heartily recommend it.

Yours very truly,

Enoch Carless, Chief Engineer, The John Illingworth Steel Co., Frankford, Pa.

The most durable and economical sheet packing in the world for every purpose; will stand any pressure and all degrees of heat without hardening. Especially good for Steam, Water, Gas, Oil, Acids, Ammonia, Alkalies, etc.

EVERYBODY'S PACKING COMPANY, Bourse Bldg., Philadelphia, Pa.

Special Agents: ERWIN & COMPANY, 56 & 58 Dearborn Street, Chicago, Ill.; ROBERT SCHWARZ, 26 Peacock Street, Buffalo, N. Y
Reliable Agents Wanted for Exclusive Territory.

MAGNOLIA ANTIFRICTION METAL

TRADE MARK

TEST No. 783

BY THE RESEARCH LABORATORY OF THE

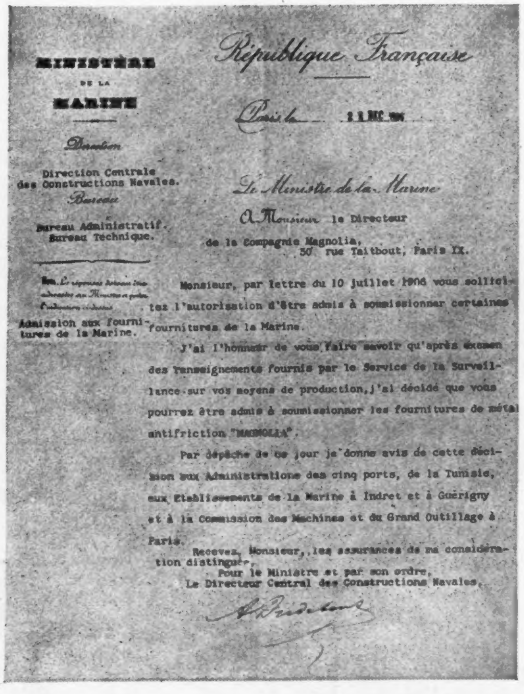
FRENCH GOVERNMENT

THESE TESTS WERE DIVIDED INTO THREE SECTIONS.

1st. Determination of the coefficient of Friction under varying pressures.
2d. Determination of temperatures under different velocities—"Endurance test."
3rd. Determination of the rate of wear.

Reports of these tests were accompanied by fourteen tabulations and the results were so highly favorable to Magnolia Metal—sustaining in every respect its well known qualities that the following letter was written by order of the Minister of Marine, approving of the use of Magnolia Metal by the French Navy.

No peoples surpass the French in scientific knowledge and highly technical painstaking investigation, and their endorsement of Magnolia Metal is another strong link in the chain of evidence that we are able to furnish.



MINISTÈRE DE LA MARINE

Direction Centrale des Constructions Navales.
Bureau
Bureau Administratif.
Bureau Technique.

Admission aux fournitures de la Marine.

République Française

Le Ministre de la Marine

A Monsieur le Directeur de la Compagnie Magnolia, 50 rue Taitbout, Paris IX.

Monsieur, par lettre du 10 juillet 1906 vous sollicitez l'autorisation d'être admis à soumissionner certaines fournitures de la Marine.

J'ai l'honneur de vous faire savoir qu'après examen des renseignements fournis par le Service de la Surveillance sur vos moyens de production, j'ai décidé que vous pourrez être admis à soumissionner les fournitures de métal antifriction "MAGNOLIA".

Par dépêche de ce jour je donne avis de cette décision aux Administrations des cinq ports, de la Tunisie, aux Etablissements de la Marine à Indret et à Guérigny et à la Commission des Machines et du Grand Outillage à Paris.

Recevez, Monsieur, les assurances de ma considération distinguée.

Pour le Ministre et par son ordre,
Le Directeur Central des Constructions Navales,

TRANSLATION

The Director of the Magnolia Co.,
50 Rue Taitbout Paris IX.

Sir: By yours of July 10, 1906, you request permission to be allowed to furnish certain Navy Supplies.

I have the honor to inform you that after examination of the information furnished by the Service de la Surveillance regarding your method of production, I have decided that you may be allowed to furnish the supplies of Magnolia Anti-friction Metal.

By telegram of this day I transmit this decision to the Administrations of the five ports of Tunisie, to the Navy Department of Indret and Guerigny and to the Commission of Machines et du Grand Outillage at Paris.

Receive, Sir, the assurance of my distinguished esteem.

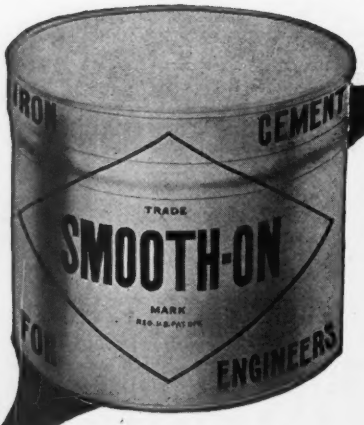
For the Minister and by his order.
The Central Director of Naval Construction,
A. DUDEBOUT.

Sold by leading dealers everywhere, or by

MAGNOLIA METAL COMPANY

NEW YORK, 114 Bank St. **CHICAGO,** Fisher Bldg. **MONTREAL,** 225 Ambroise St.

SPECIAL OFFER **Practical Engineer Pocket Book,** containing 680 pages, treating on over 2,000 Engineering and Mechanical subjects brought up to date. We offer this valuable reference work at the very low price of 40c, postage prepaid. Address New York office.



SEND FOR FREE INSTRUCTION BOOK

THIS Smooth-On Instruction Book tells precisely how to make innumerable permanent repairs to boilers, engines, castings, tanks, etc., using the well known Smooth-On Iron Cements. Every engineer should have a copy at once. Smooth-On used right is the most remarkable time and money saver known for the engine and boiler room.

SMOOTH-ON MANUFACTURING COMPANY

572-574 Communipaw Ave.
Jersey City, N. J., U. S. A.

Chicago Warehouse,
231 N. Jefferson Street.

San Francisco Warehouse,
94 Market Street.

English Branch,
8 White Street,
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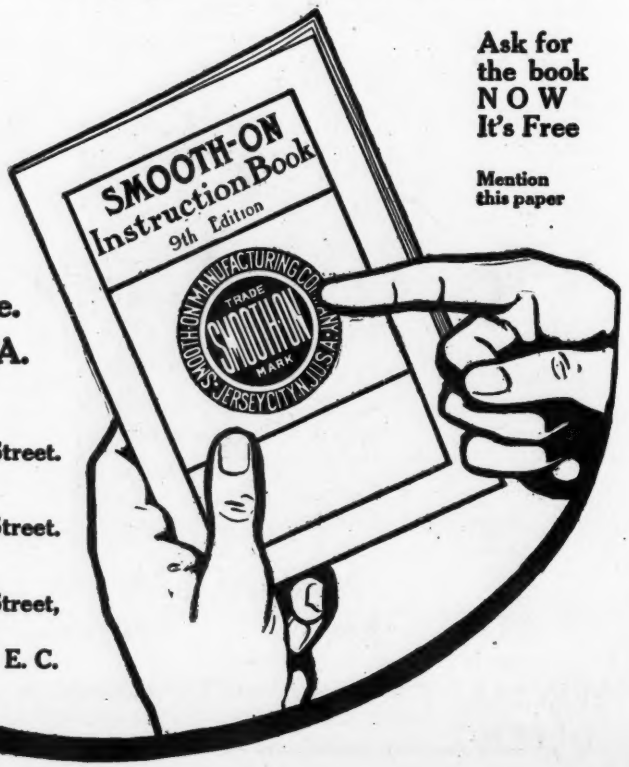
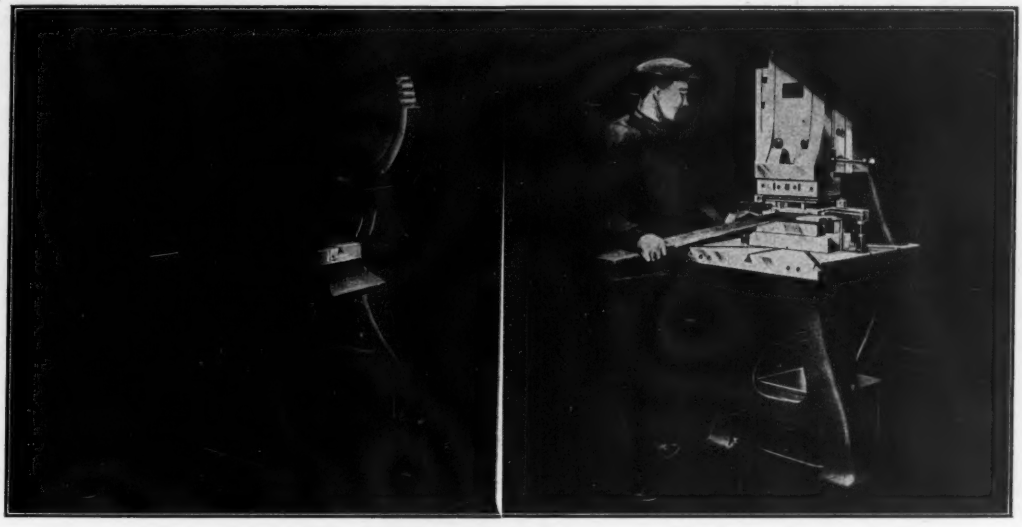


Ask for the book NOW It's Free

Mention this paper



HELP YOUR MEN TO MAKE GOOD

Don't discount their work by impairing their personal efficiency. Let them give full value.

You are certain that were you personally deprived of good light for two or three hours each afternoon you would soon notice a decrease in your work both in quality and quantity.

The man in the shop is more dependent on light than you are. He may not realize it, he may have become accustomed to working in semi-darkness, but with an improvement in your lighting you will certainly find an improvement in the work. We have made practical tests; we are certain of our results. We are willing to prove our statements.

SHELBY MAZDA ARCS

are practical lighting units which economize current and maintenance economy with highest quality of light. Let us show you in your own shop exactly what we can do.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio

Shelby Mazda Arcs consist of 4 Series Mazda lamp reflector ana fixture complete. They give 500 c. p. at 400 watts.. They are interchangeable on A. C. or D. C., and require no trimming or adjusting. Least expensive of artificial illuminants.

Increase the Efficiency

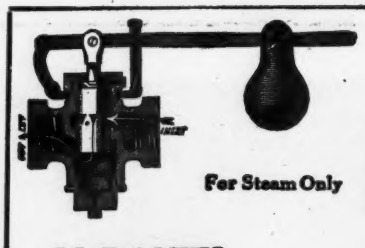
of your power plant by installing a Rope Drive. It takes up less space than a belt drive, is noiseless and transmits the power more regularly.

COLUMBIAN

Manila Transmission Rope is the most economical rope to use on any Rope Drive. It is made of the strongest kind of fibre, imported from the Island of Cebu. The machines that manufacture it are designed especially for making Transmission Rope. COLUMBIAN Rope on any drive will give the longest possible service.

Order some COLUMBIAN Rope today.

COLUMBIAN ROPE CO.,
817-859 GENESEE STREET
AUBURN, N. Y.



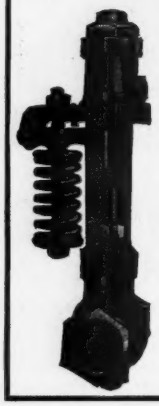
For Steam Only

WATSON
Reducing Valve

For Steam Heating or other places requiring low pressure. It is the simplest Reducing Valve on the market, and will outlast and work better than any other.

McDANIEL
Improved Steam Trap

Will discharge the condensation and prevent steam blowing through. Every one guaranteed by us. Sent on trial.



WATSON
Steam Pump Governor

Should be used on all steam pumps where a fixed discharge pressure is desired.

The construction permits of easy access to the stuffing box for removing packing, and the spring can be adjusted or entirely removed without interfering with any other part of the valve. Any practical man will readily see its advantages.

Send for Catalog.

Watson & McDaniel Co.,
147 North 7th St., Philadelphia, Pa.

SPECIFY "AMERICAN" WIRE ROPE IN YOUR NEXT ORDER

Long Service from Equipment is a Matter of Economy in All Power Plants

The durability of American Wire Rope means a great saving in the expense of power transmission. It embodies all the qualities that combine to render highly profitable service. For hoists of every description, elevators, conveyors, derricks or for the transmission of power it is unquestionably superior to all other grades. It has set a high standard for efficiency and reliability, which is due primarily to the careful selection of material and superior facilities for its manufacture. Skilled experts guide its production through the various intricate branches of making to the finished product—the best wire rope that experience can put forth.

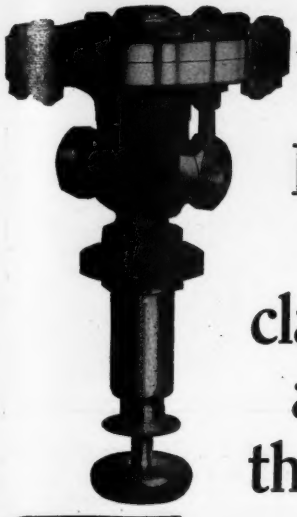
New standard strengths, weights and list prices were adopted May 1, 1910. Send for new catalog and copy of "American Wire Rope News," illustrating and describing the new standard strengths.

AMERICAN STEEL & WIRE COMPANY

Chicago New York Worcester Denver San Francisco

United States Steel Products Co., 30 Church Street, New York, Export Representative

USED IN THOUSANDS OF POWER PLANTS THE WORLD OVER



It is not what is claimed for a device that counts

but what it does in actual service.

OHIO Pressure Regulating Valves

are sold on the broad guarantee that they will operate to your satisfaction or they can be returned at our expense.

Hundreds of OHIO Valves have been sent out, subject to the above guarantee, for all kinds of exacting service, and we have yet to hear that even one has failed.

Why don't you give them a trial?

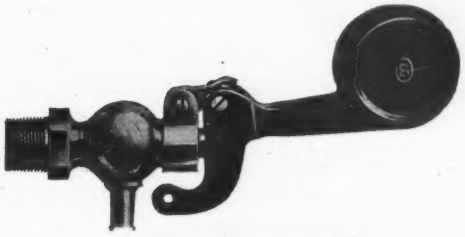
Catalog H-E contains listing of full line of OHIO Steam Specialties. Write for it.

The Ohio Brass Co.

Mansfield, Ohio, U. S. A.

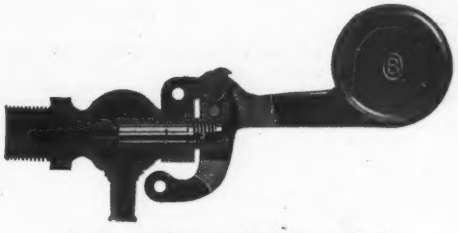
ENGINEERS

If you want a Gauge Cock that *never leaks*, that can be ground to a seat *instantly*, with the pressure on—



Ohio Standard Gauge Cock

Babbitt Disc and Rotating Screw



Sectional View of Ohio Gauge Cock

Simply order some

OHIO Standard Gauge Cocks

¶ *Positive* in action and *absolutely tight* in service.

¶ Babbitt Disc "1" (see views above) is connected to Adjusting Screw "2" and can be quickly ground to a *perfect* seat, while steam pressure is on, by simply rotating the Screw "2" with a screw driver.

¶ The Weight does not interfere with the grinding and *automatically* adjusts itself to proper position.

¶ A new Disc can be inserted by simply taking out Screw "2."

Full listing of OHIO Steam Specialties, Pressure Regulating Valves, Etc., in Catalog H-E. Write for your copy today.

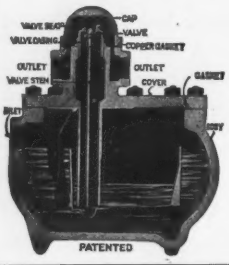
THE OHIO BRASS CO.

MANSFIELD, OHIO, U. S. A.

REMEMBER THE SQUIRES

STEAM TRAPS

FOR SERVICE

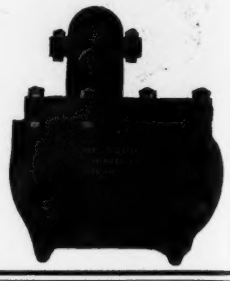


Let us send you one or more traps subject to your approval.
Write for Catalog E-9.

THE C. E. SQUIRES CO.

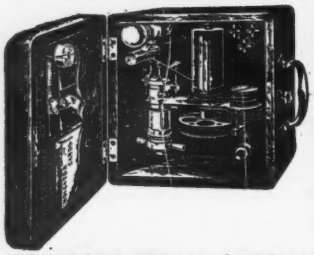
Manufacturers of Steam Specialties

1426 West Third Street CLEVELAND, OHIO



THE LIPPINCOTT INDICATOR

REDUCING WHEEL AND PLANIMETER

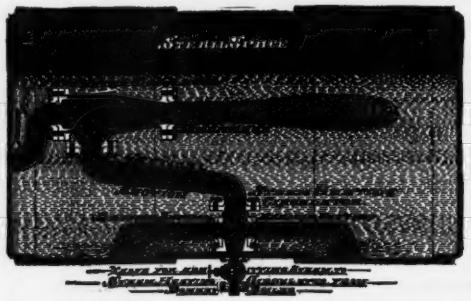


You'll get better value for your money with a Lippincott Indicator outfit than you could possibly get elsewhere. We manufacture a remarkably complete line and can give you an instrument at a price which will fit your pocketbook.

Write for our Catalog.

LIPPINCOTT STEAM SPECIALTY AND SUPPLY CO.
Newark, New Jersey.

GOOD CIRCULATION Is The LIFE Of Your BOILER, bad circulation will be the **death** of it, and you will soon have to bury it in the scrap pile. The **EQUILIBRIUM CIRCULATOR** will put new life into your old boiler; increasing capacity, saving coal and repairs.

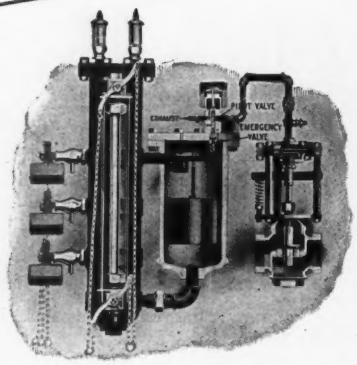


Write for Catalog showing all types of boilers.

H. BLOOMSBURG & CO., 425 N. Carey St., BALTIMORE, MD.

KITTS

Safety Feed Water Regulator



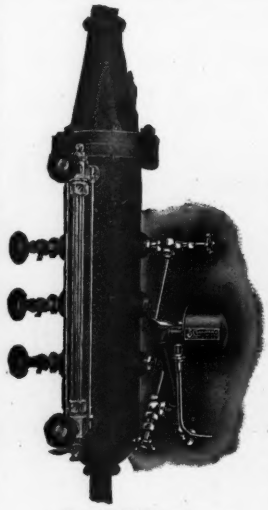
Assures the greatest possible efficiency from absolutely dry steam. A constant water level in your boiler. Minimum repair bills.

Prevents possible disasters from high or low water.

REDUCING VALVES. PUMP GOVERNORS. STEAM TRAPS. DAMPER REGULATORS

Calalog on request.

KITTS MANUFACTURING CO., Oswego, N.Y.
Pittsburg, 525 Third Ave. New York, 143 Liberty St.



The "S-C" Regulator.

BEST BY TEST

What the **"S-C"** Water Level Regulators and Pump Governors are doing in the Phoenix Furniture Co.'s plant at Grand Rapids, Mich., they will do for you.

The chief engineer had the columns blown down twenty times the first day fearing they had stopped up as there was absolutely no variation in the water.

The engineers who have seen them like them; others would like to see them.

We have a Catalog for you.

"S-C" Pump Governor

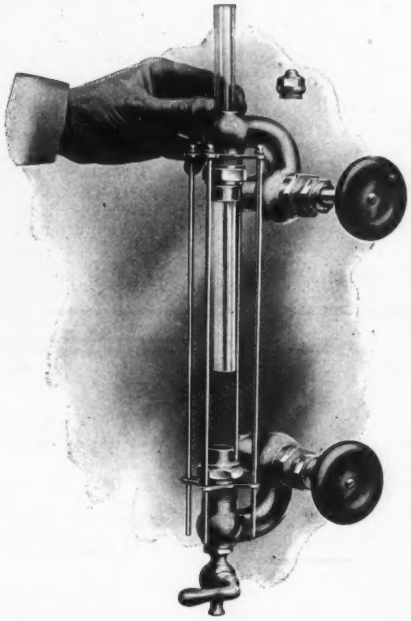
The "S-C" Regulator Co.
311 PERRY STREET
FOSTORIA, - - OHIO

Swartwout Automatic

Safety Water Gauge

Eye Insurance

When you buy a water gauge do you also purchase eye insurance? The Swartwout Automatic Safety Gauge is the best eye insurance you can get. Believing in the adage, "an ounce of prevention is worth a pound of cure," we have made the Swartwout Gauge so that the valves close surely and instantly when a glass breaks. When boilers are equipped with Swartwout Water Gauges you will never hear the engineer or fireman say, "Do you see that scar?" or "Do you see this mark?" There's no flying glass to make scars or marks when the steam is cut off instantly as in the Swartwout Gauge.



Another distinctive feature is the goose-neck construction. This makes the gauge flexible and brings less strain on the glass as it heats up. The glass is much easier to clean and to replace if broken. You can both clean and replace the glass without disturbing the connection to the boiler.

Swartwout

Automatic Safety Water Gauges

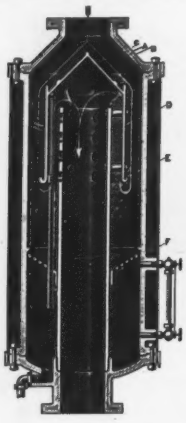
Cast Iron Exhaust Heads
Centrifugal Separators
Rotary Ball-Bearing Ventilators

Manufactured by

The Ohio Blower Company

1-138

330 Michigan Street **Cleveland, Ohio**



Sweet's Separators

extract the condensation water or oil without the least danger of back pressure. The upper part of the separator presents a rough surface to the steam, takes out water and oil and carries them beyond reach of steam. The lower part serves as a large tank. They are a proven success—that's why 50 per cent of all Sweet's Separators in use today have been sold on repeat orders. Our catalogue is well worth having and it's free. Send for it today.

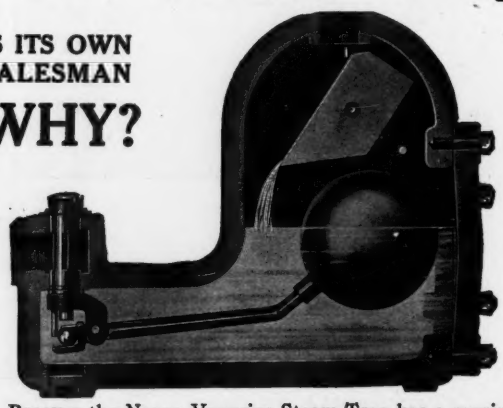
THE DIRECT SEPARATOR COMPANY THE SWEET

820 Geddes Street Syracuse, N. Y.

This Steam Trap

IS ITS OWN SALESMAN

WHY?



Because the Nason-Vesuvius Steam Trap has a regrinding ball valve that rotates at each discharge.

Because it has a large discharge orifice that allows the steam system to be quickly freed from all condensation.

Because it has an intermittent discharge that reduces the wear of the seat to one-tenth that of any other trap.

Because it discharges the condensation quickly with no loss of steam.

Because it is a steam trap that gives universal satisfaction to every user.

Because it appeals to every engineer who knows what a perfect steam trap should be.

Because it is a Nason product, the result of seventy years experience.

Send for our catalogue.

NASON MFG. CO., 71 Fulton Street, New York

Anderson Improved Steam Trap

The TRAP You Ought to Have

If you want genuine steam trap service install an Anderson Improved Steam Trap. Its operation is automatic and *absolutely reliable* — a steady drainer and simple in construction throughout. Valve and seat are of phosphor bronze and you can remove the seat without breaking a steam joint or connection.

The Anderson Float is our own invention and the only perfect float made. Whether in price, service or satisfaction, you can't do better than get an Anderson trap.

Our Catalog contains a lot of information you can use whether you get an Anderson Trap or not. It's Free.

The V. D. Anderson Company

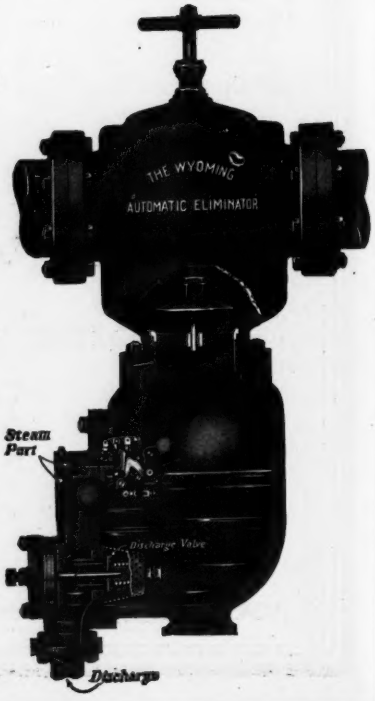
1937 West 96th Street, - - - Cleveland, Ohio.

"WYOMING" AUTOMATIC ELIMINATOR

Keeps the water out of your steam line.

A combination Steam Separator and Trap.

Our Catalog tells more—write for it.



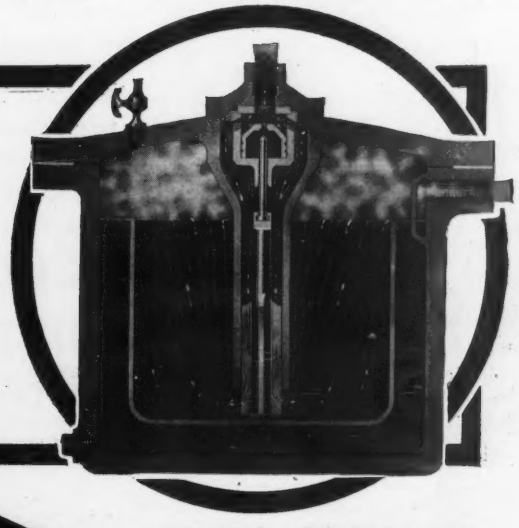
Manufactured by

W. H. Nicholson & Company

Wilkes-Barre, Pa.

AGENTS:
Chas. N. Hays Co., Pittsburg, Pa.
Alex. Middlebrook, Denver, Colo.

THE REMARKABLE VALVES



OF THE VANCE STEAM TRAP

which have 4 to 10 times greater area and give the Vance 100% to 500% greater capacity than any single valve bucket trap.

Now don't pass this statement up as a **mere claim**—if it seems impossible to you just take the time to note our reasons and see for yourself.

The **first** thing you want to get firmly in your mind is that the Vance has a **double** valve where present bucket traps have **single** valves.

Next—just note from the cut about how this double valve increases the valve area of the Vance from 4 to 10 times over the inadequate area of single valves. As an example of the difference in size of the **Vance area** and **single valve areas,** note the opening in the Vance auxiliary valve alone—now this is just the size of the **entire** valve area of most single valve bucket traps. The larger opening (which you can see above) of the **main** valve of the Vance, is all extra and above the other traps, and is where the 4 to 10 times greater capacity of the Vance is made up.

Maybe you wonder why the single valve trap makers can't simply enlarge their area to this size.

Well, the point is, that the larger the opening the more weight you require to open the valve, and to get a bucket large enough to have weight enough to open a **single** valve with an area as large as this **Vance,** would make a trap prohibitive both in size and expense.

Have we made ourselves clear?

We would like to go on and tell all the other advantages of these valves and other features of the Vance, but we haven't the room here.

However, if you're open to conviction as to the enormous economy of the Vance we'll give you the proofs; **complete** information, etc.

And back it all up conclusively by putting a Vance right up beside the traps now in your plant for a 30 day comparative demonstration, where you can watch it for yourself, and if it doesn't save you all we claim, then we'll take it right out without it costing you one cent.

Now if you'll send in the attached coupon or accept our offer of free trial, we'll send you by return mail one of the Vance Trap inkwells. It is an exact metal and glass reproduction of the Vance itself, and makes both a practical and ornamental gift for your desk.

Send in the coupon before you forget—please

Gentlemen: Please send me one of your souvenir inkwells together with literature on the Vance Steam Trap. adv. in Prac. Eng. Dec.

COUPON

Name .....

Position .....

Home Address .....

Firm .....

Firm Address .....

No. of traps in use.....

Dealer's name .....

Geo. M. Newhall Engineering Company

DEPARTMENT OF SUPPLIES

134 South Fourth Street, - PHILADELPHIA, PA.

Chicago Sales Agent, T. J. McMaster, 809 Ashland Block, Chicago, Ill.

If your dealer hasn't the Vance, send us his name and we'll send him full information.

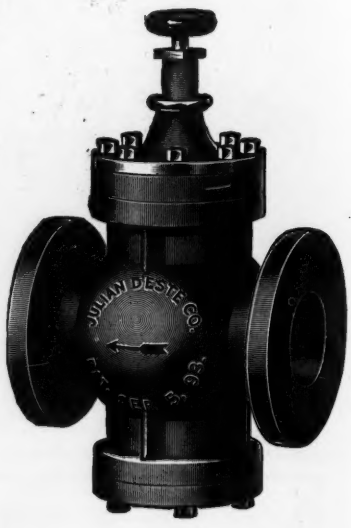
Damper Regulator

CURTIS SPECIALTIES PAY FOR THEMSELVES IN GOOD SERVICE

SURE SECURITY

You can cut down pressure to any amount, and leave it so for any length of time with perfect safety by using the

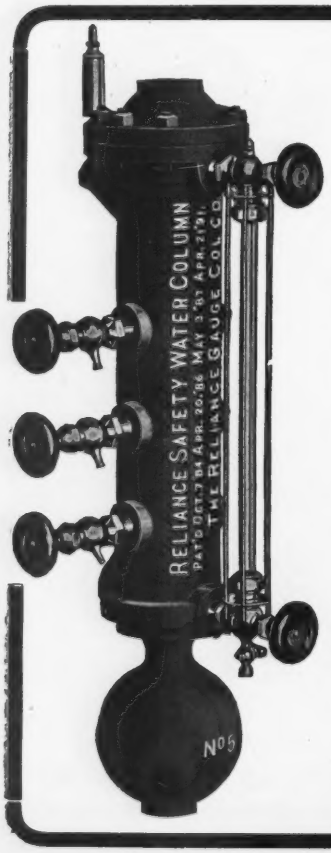
Curtis Improved Pressure Regulator



Described in our 1910 Catalog. Sent free on Request.

No Packing—No Glands—Simple—Strong—Sure.

Julian d'Este Company,
24 Canal St., Boston, Mass.

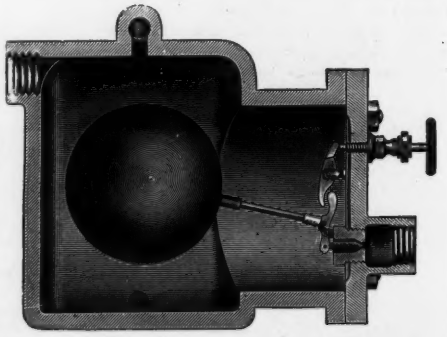


In Buying Power Plant Equipment

you judge, to a certain extent, the value of the apparatus desired by its present-day demand. The **Reliance Safety Water Column** is conceded the most dependable device for protection against boiler explosions and inattentive help, and for this reason has created a market, so responsive, that over 70,000 Reliance Columns are in use today. Aside from its great dependability as guardian of the boiler, is the direct economy resulting from its service. Saves fuel and repairs—prevents costly shut-downs and prolongs boiler life considerably. We publish a catalog and it's well worth having. Send for it **today.**

The Trap With Enormous Capacity

is the one you need and ought to have in your plant. It's the ever-dependable Reliance Steam Trap. Takes care of any volume of water. Internal mechanism simple and void of complicated parts. Removable cap allows easy access to interior. There are no weak or faulty points about the Reliance. It is positively without comparison. Yes, we have a catalog waiting for your address. Send it **NOW.**



THE RELIANCE GAUGE COLUMN CO.
72 East Prospect Street, CLEVELAND, O.
EASTERN OFFICE: 1219 Betz Building, Philadelphia
WESTERN OFFICE: 43-45 Franklin Street, Chicago

Davis Pressure Regulators Save Steam

Davis No. 2 Pressure Regulator

STUDY the design of the Davis Pressure Reducing Valve and you will find the reason for its universally successful operation under every conceivable working condition.

It has no complicated or delicately adjusted parts—no diaphragm to break—no packing to bind—no auxiliary valves to leak—no small ports to clog—no springs or toggles to contend with.

You know that the simplest automatic device is the best. Construct it so as to eliminate as far as possible all liability of trouble and it will serve you well.

That was the idea followed by the inventor of the Davis Regulator. He designed a valve that accomplishes its purpose by the most direct means. Its simplicity makes for reliability and long life. That's why it is to be found in the most modern and prominent plants in the country—why it should be in your plant.

Let us send you one of these valves on approval. You will not be obliged to keep it if there is a shadow of doubt regarding its value to you.

G. M. Davis Regulator Co.

427 Milwaukee Ave., Chicago

Makers of the Davis Steam Trap, Exhaust Relief Valve, Stop and Check Valve, Back Pressure Valve, Float Valve, Pump Governor, Balanced Valve and other Specialties.

New York	Boston	Philadelphia	Pittsburg	St. Louis	San Francisco	Minneapolis
123 Liberty St.	70 High St.	56 N. Second St.	Park Bldg.	735 S. Fourth St.	Metropolis Bank Bldg.	500 Bk. of Com. Bldg.

Every Genuine Mason Reducing Valve

Bears This Mark

The Mark of Known Quality

That mark is cast into the body of every genuine **Mason** Reducing Valve to protect **you** from the disappointments that invariably come with the purchase of an imitation.

When you buy a Valve bearing that mark, you **know** you are getting a Mason, and you have **our guarantee** of satisfactory service. You have the assurance that you are getting a Full Area Valve—a Valve that will give you the **closest, most exact regulation** to be had—one which will take prompt and effective care of all fluctuations of either steam or air pressure—one that **cannot** be "monkeyed" with, accidently or "with malice aforethought," because **you hold the key** that gives access to the adjustment, and one that does its work without chattering or pounding.

When you buy a Valve bearing that mark you buy the results of nearly **a third of a century** of priceless experience in the designing and manufacture of Reducing Valves, and you get something that's worth its price, because it eliminates waste, trouble and uncertainty.

If you haven't a copy of the Mason Catalog that describes this and other Mason Regulating Devices in detail, by all means write for it at once. **It is worth money to you.**

"KEY TO STEAM ENGINEERING"

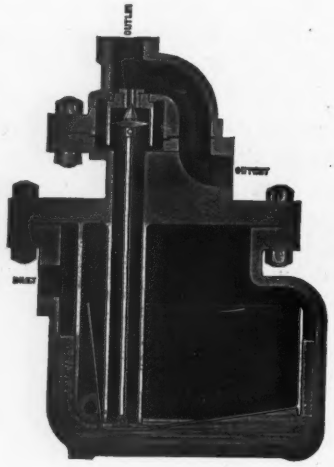
Is a 198-page handbook to remind the experienced engineer of things forgotton or imperfectly remembered, and to help the beginner to a firm grasp on the basic principles of his profession. It is a book of Questions and Answers, condensing a tremendous amount of real information into a small compass, written in clear-cut, understandable style and arranged for easy reference. It is worth dollars of any engineer's money. The regular price is 50 cents, but it carries a condensed catalog of Mason Regulating Devices (12 pages) so we pass it on to you at the quantity price to us, post paid for **25c**

The Mason Regulator Company, 160 Summer Street Boston, Mass.

We Have Opened Another Branch

This One in Chicago at 564 West Randolph Street

REGISTERED TRADE 4/S MARK



"The basis of a growing business is honest goods that are right."

SEND FOR CATALOG E

OF OUR

STRONG

STEAM TRAPS	SEPARATORS { OIL / STEAM
VACUUM TRAPS	FLANGE WRENCHES
RETURN TRAPS	HOSE CLAMPS
PUMP GOVERNORS	PRESSURE REGULATORS
ENGINE STOPS	QUICK CLOSING VALVES

THE STRONG, CARLISLE & HAMMOND CO., 346 Frankfort Ave., CLEVELAND, O.

432 Wood St. PITTSBURG | 180 High St. BOSTON | 261 Center St. NEW YORK | 564 W. Randolph St. CHICAGO | 908 Chestnut St. PHILADELPHIA

AN OPPORTUNITY TO OWN A

TABOR INDICATOR

WITH OUTSIDE SPRING

The Tabor Indicator is the most economical because—

First. It has a small number of wearing parts and no lost motion as in other indicators. Accurate when you get it and stays accurate.

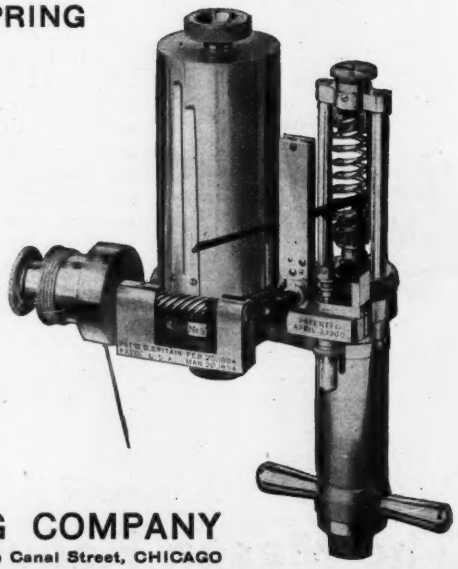
Second. Notwithstanding its accuracy, it is substantially built and will give the best service for many years without even the smaller repairs.

Third. The Tabor Indicator will last a life-time. A number of the first Tabor Indicators built thirty years ago are still doing their work and doing it right.

Fourth. The few adjustments are more quickly made than the more numerous ones in other indicators.

Fifth. Because of all of the above and other special features and qualities, it is THE BEST engine indicator made, and the old saying about "the best is always the cheapest" applies to indicators particularly.

Send for special offer—It is made to Operating Engineers only.



THE ASHCROFT MANUFACTURING COMPANY

85-87-89 Liberty Street, NEW YORK — 111-115 North Canal Street, CHICAGO

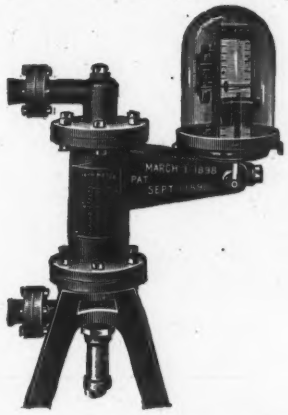
Now
Is The Time

to figure your heating for next winter. Cut your heating bills 25 to 35 per cent. by installing our Atmospheric System of Steam Heating.

Write for information and Bulletin 119. It's free.

American District Steam Company,
Lockport, N. Y.
North Tonawanda, N. Y. Chicago.

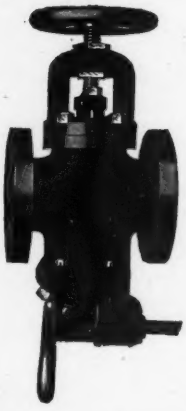
It Pays to Have a Daily Record of Your Steam Consumption



Nothing can equal the St. John Indicating and Recording Steam Meter for aiding you in keeping down power costs and helping you to get full returns from your coal pile. It keeps an accurate record of the amount of steam delivered every minute. This record is made on charts which can be filed permanently and used for future reference in determining whether or not you are wasting power. It is simple in construction and does not interfere with the flow of the steam. It soon saves its cost and thereafter is a dividend earner. Our booklet describes it in detail

G. C. ST. JOHN, 90 WEST STREET, NEW YORK CITY.

You May Have Noticed That We Have Never Enthused Over Valve Stops

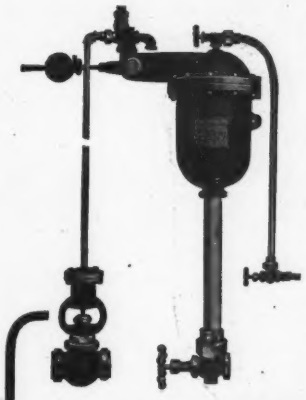


We have simply said to you that if you really wanted a valve stop, we had the best one. And that was true, for all the others were designed on principles which we had long ago tried out and discarded. We were not satisfied even with our own Valve Stop, so we've been studying for years to produce a Valve Stop which should be free from the faults of all the others.

At Last We Have It In Our Throttle Valve Type

It's *electrically* actuated—gravity principle—operated by a weight. It is not *steam*-actuated. And therefore it *cannot* "freeze," "slam" nor "chatter;" nor can wire "drawing" or "scale" impair its efficiency. But it is useless to attempt description here. *Write for Our Advance Bulletin* and find out why you can *now*, for the *first* time, get a Valve Stop which, while it can be placed in the steam line if desired, is *not* actuated by steam and is free from *all* the many objections to the valve stops of the old type.

Consolidated Engine Stop Co.
119-121 East 28th Street : : New York, N. Y.



RE-ENFORCE YOUR BOILER

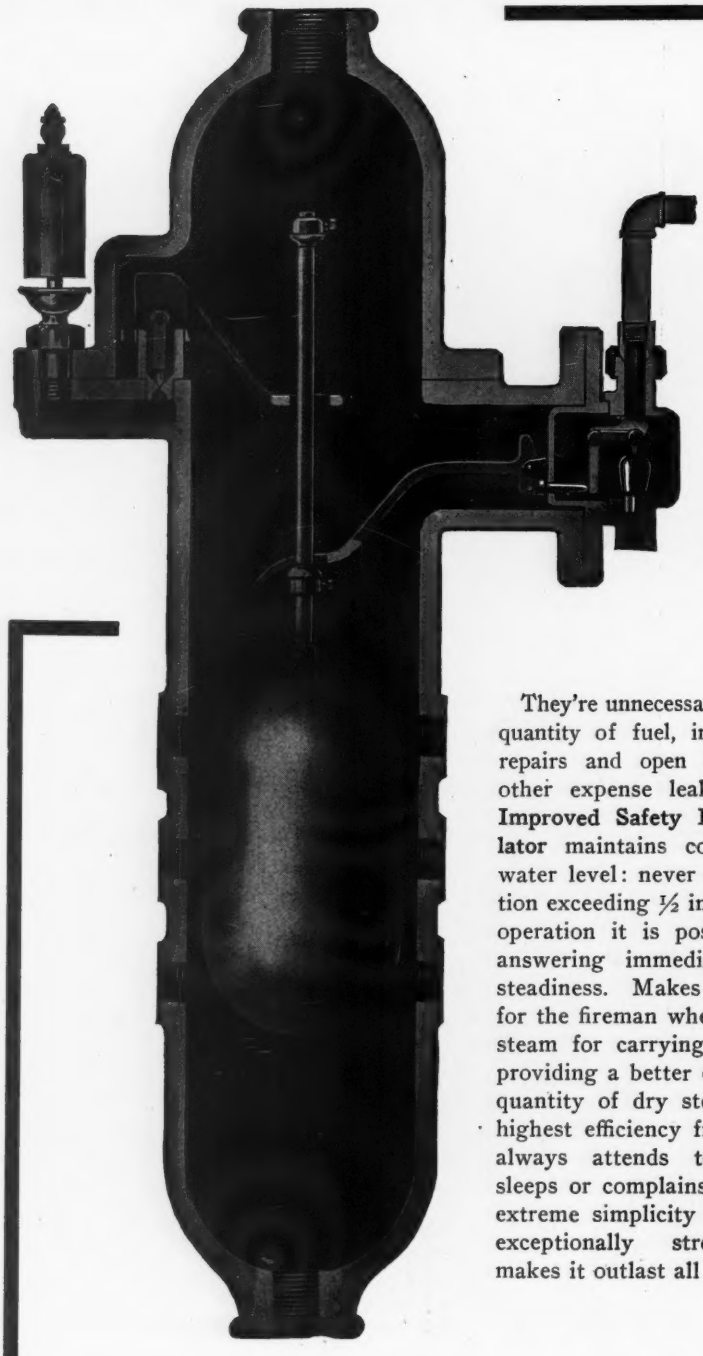
with a dependable regulator—one that looks after your interest day after day without a minute's rest—one that brings actual results from service rendered—results that mount high on the profit side of the ledger.

WITH THE VIGILANT FEED-WATER REGULATOR

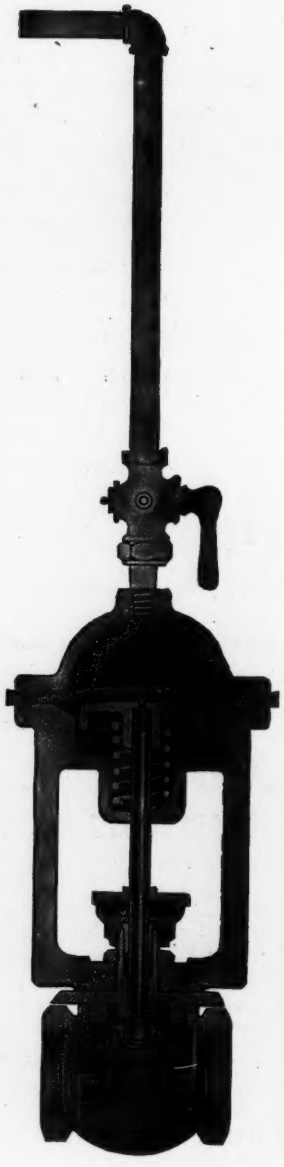
attached to your boiler you are not only protected from boiler explosions and the consequent injury to life and property, but also from an unnecessary waste of fuel due to inattention on the part of the fireman in allowing the water to run low, then heaping on an extravagant amount of coal to catch up. In addition to this the Vigilant lowers labor costs and assures increased efficiency all around. By all means, send for our catalog, it contains information of specific value to all power users. Do it **NOW** before it escapes your attention.

The Chaplin-Fulton Mfg. Co., Pittsburg, Pa.
Also Manufacturers of the Fulton Pump Governor

Represented by D. W. Patterson, Harrison Bldg., Philadelphia; I. E. Gimperling & Son, Dayton, O.; J. S. Ward, Chicago, Ill.; H. H. Davis, Oliver Bldg., Boston.



Don't Tolerate Fidgety Water-Levels



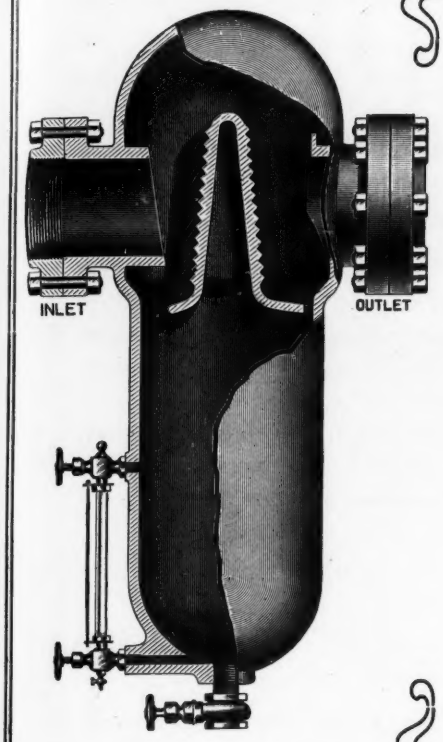
They're unnecessary and waste a great quantity of fuel, increase the need of repairs and open the door to many other expense leaks. The **Williams Improved Safety Feed Water Regulator** maintains constantly a proper water level: never allowing a fluctuation exceeding ½ inch, up or down. In operation it is positive and reliable, answering immediately to any unsteadiness. Makes work much easier for the fireman when putting on extra steam for carrying an overload. By providing a better quality and greater quantity of dry steam it assures the highest efficiency from equipment. It always attends to business—never sleeps or complains of overwork. Its extreme simplicity combined with its exceptionally strong construction makes it outlast all others.

You simply cannot do without our catalog and it's free. Describes, in detail, Williams Steam Specialties — Regulators —Steam Traps—and Pump Governors. Send your address today.

The Williams Gauge Company

643 Fourth Avenue, PITTSBURG, PA.

Chicago Office, 218 La Salle Street



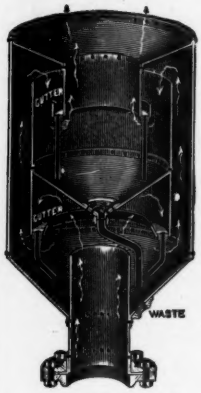
Installed in a horizontal steam line as near the throttle as possible, this

Austin Figure "E" Horizontal Iron Receiver Steam Separator

is a guarante that absolutely no water can reach the cylinders; that only DRY STEAM will be used as an operative and that, you KNOW, means that you'll get the best service your engine is capable of, at the least cost of fuel and lubricant with positive insurance against cylinder explosions. We ship our Separators on trial. Send for the catalog D30.

Austin Separator Co.

Detroit, Mich. **23 Woodbridge St.**



Great internal area insures perfect separation and no back pressure.

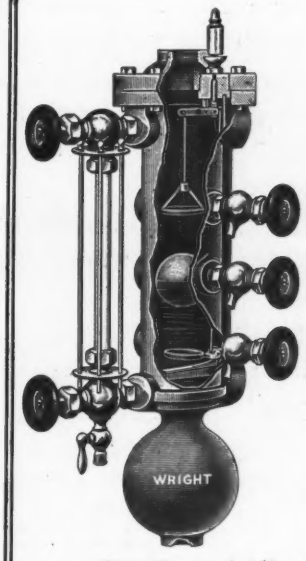
Wright "Cyclone" Exhaust Heads

Keep the oil, water, etc., from spraying with exhaust steam over the roofs, walls, walks, etc.

Stick your own head out of any office-building window and you'll see our "heads" bobbing up over the roofs most anywhere. They're in general use because they last and do good work. Send for the catalog C80. We ship on trial.

Wright Manufacturing Co.

Detroit, Michigan **72 Woodbridge St.**



Government and State Approved

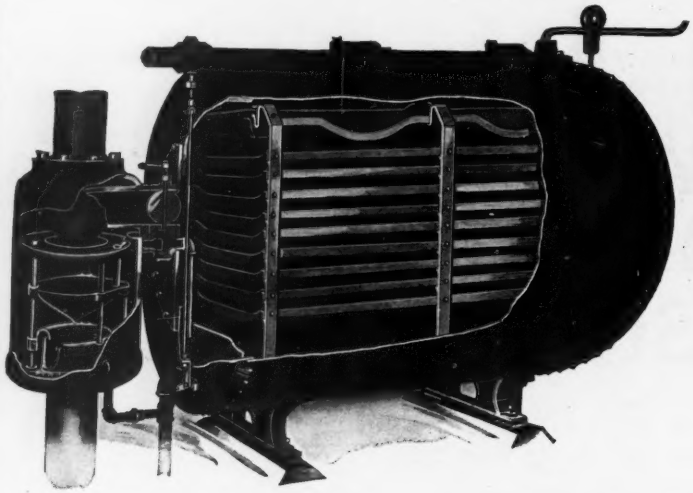
Wright Improved Safety Alarm Water Columns

ought to be your standard if they're not.

One Round Float, One Vertical Valve and the Whistle compose their working parts. Couldn't be more simple. Send for catalog C80. We ship on trial.

Wright Manufacturing Co.

Detroit, Mich. **72 Woodbridge St.**



HOPPES
FEED-WATER HEATER
with INDUCTION CHAMBER

The Hoppes Induction Chamber, as shown in cut, is designed to meet the demand for a convenient and inexpensive method of connecting up a feed-water heater on the induction principle where part of the exhaust steam is used for heating or drying system or passed to atmosphere, and also to afford a ready means of by-passing the exhaust steam and cutting out the heater for cleaning or inspection.

It does away with several large valves and fittings usually required in the piping work—a saving proportional to the size and number of fittings displaced.

It takes the place of an independent oil eliminator for the exhaust to heating system, as it removes the oil from this as well as that going to heater.

It allows the heater to be cut in or out by a single turn of its valve lever—a great convenience for the engineer.

It can be used in connection with Hoppes Heaters of any size or type, and when so used, the saving is a double one, as Hoppes Feed-Water Heaters, on account of their large heating and lime-catching surface, always assure the highest temperature for the feed-water that it is possible to obtain from exhaust steam.

The price of this apparatus is reasonable and almost nominal in comparison with the saving and convenience it affords, so if you are figuring on the piping for your feed-water heater and heating system, let us hear from you, as we are confident that we can save you money.

HOPPES LIVE STEAM FEED-WATER PURIFIERS

KEEP BOILERS CLEAN WITHOUT CHEMICALS. WRITE FOR PARTICULARS.

HOPPES STEAM SEPARATORS deliver 99% or better dry steam without "wire-drawing," and their large receiver capacity thoroughly protects the engine from water.

HOPPES OIL ELIMINATORS thoroughly remove the oil and water from the exhaust steam without back pressure.

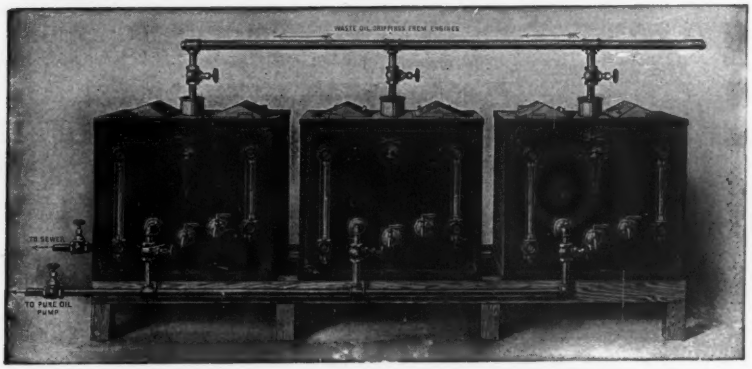
HOPPES CAST IRON EXHAUST HEADS keep roofs dry and clean and will not rust out.

Catalogs Free

HOPPES MANUFACTURING CO.

70 Larch Street, - - - SPRINGFIELD, OHIO

They Have a Battery of Seven Units



Three "Units" Connected and Operated as One Filter

The Burt System Continues to Give Excellent Results

Nazareth Cement Company,

NAZARETH, PA., April 25, 1908

The Burt Mfg. Co., Akron, O.

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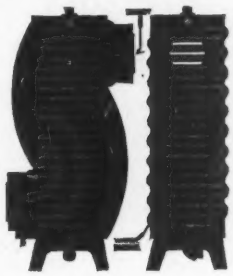

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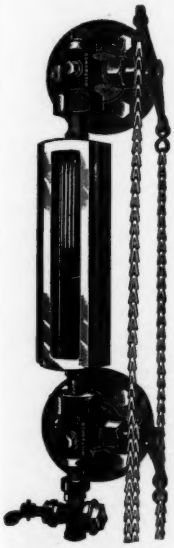

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Terry Steam Turbine Co., The, Hartford, Conn.

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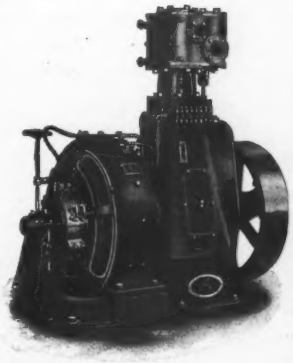

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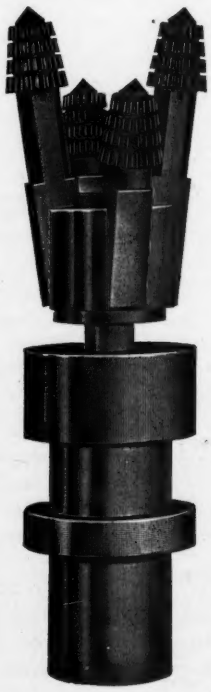

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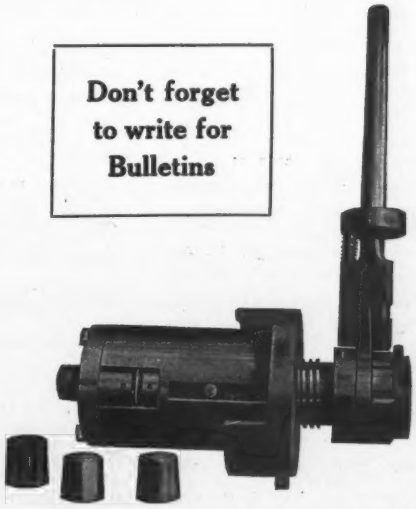

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Brownell Co., The, Dayton, O.
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Cooper Co., C. & G., Mt. Vernon, Ohio.
De Laval Steam Turbine Co., Trenton, N. J.
Fulton Iron Works, St. Louis, Mo. "Fulton-Corliss."
General Electric Co., Schenectady, N. Y. "Curtis."
Ide & Sons, A. L., Springfield, Ill. "Ideal."
Harrisburg Foundry & Machine Works, Harrisburg, Pa. "Fleming-Harrisburg."
Hooven, Owens, Rentschler Co., Hamilton, O. "Hamilton-Corliss."
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Russell Engine Co., Massillon, O.
Skinner Engine Co., Erie, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Terry Turbine Co., New York.
Valley Iron Works, Williamsport, Pa. "Lycoming."
Westinghouse Machine Co., Pittsburg, Pa.
York Mfg. Co., New York.

ENGINE STOPS.
Consolidated Engine Stop Co., New York, N. Y.
Foster Engineering Co., Newark.
Strong, Carlisle & Hammond Co., Cleveland, O.

EXHAUSTERS, GAS.
Ohio Blower Co., Cleveland, O.
Sturtevant Co., B. F., Hyde Park, Mass.

EXHAUST HEADS.
Burt Mfg. Co., Akron, O. "Standard."
Direct Separator Co., Syracuse, N. Y.
Hoppes Mfg. Co., Springfield, O.
Ohio Blower Co., Cleveland, O. "Swartwout."
Robertson & Sons, Jas. L., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
Wright Mfg. Co., Detroit, Mich. "Cyclone."

FANS, ELECTRIC.
General Electric Co., Schenectady, N. Y. "G. E."
Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

FANS, EXHAUST AND VENTILATING.
Anderson Co., The V. D., Cleveland, Ohio.
General Electric Co., Schenectady, N. Y. "G. E."
Ohio Blower Co., Cleveland, O.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

FEEDERS, COMPOUND.
Stephenson Mfg. Co., The, Albany, N. Y.

FEED WATER CONTROLLERS.
Chaplin-Fulton Mfg. Co., Pittsburg, Pa. "Vigilant."
Jerguson Mfg. Co., Boston, Mass.
Kitts Mfg. Co., Oswego, N. Y. "S-C" Regulator Co., Fostoria, O.
Squires Co., The C. E., Cleveland, O.
Strong Carlisle & Hammond Co., Cleveland, O.
Williams Gauge Co., Pittsburg.

FEED WATER FILTERS.
Griscom-Spencer Co., New York. "Reilly Multicoil."
Keystone Chemical Mfg. Co., Philadelphia, Pa.
New York Continental Jewell Filtration Co., New York.
Northern Water Softener Co., Madison, Wis.

FEED WATER HEATERS AND PURIFIERS.
Alberger Condenser Co., New York.
Baragwanath & Son, Wm., Chicago.
Bates Machine Co., Joliet, Ill. "Cookson."
Brownell Co., The, Dayton, O.
Griscom-Spencer Co., New York. "Reilly Multicoil."
Harrison Safety Boiler Works, Philadelphia, Pa.
Hoppes Mfg. Co., Springfield, O.
Jacobs & Co., Chas., Boston.
National Pipe Bending Co., New Haven, Conn.
New York Continental Jewell Filtration Co., New York.
Open Coil Heater & Purifier Co., Indianapolis Ind. "Stickle."
Patterson & Co., Frank L., New York, N. Y. "Patterson Berryman."
Platt Iron Works Co., Dayton, Ohio.
Robertson & Sons, Jas. L., New York.
Russell Engine Co., Massillon, O.
Stewart Heater Co., Buffalo, N. Y. "Otis."
Williams Tool Co., Erie, Pa.

FILTERS, OIL.
Burt Mfg. Co., Akron, O. "Cross."
Flower, Walter L., Steam Specialty Co., St. Louis, Mo. "Acme."
Liberty Mfg. Co., Pittsburg, Pa.
Richardson-Phenix Co., The, Milwaukee, Wis.
Robertson & Sons, Jas. L., New York.
Wright Mfg. Co., Detroit, Mich.

FIRE BRICK.
Betson Plastic Fire Brick Co., Rome, N. Y.
Borgner, Cyrus, Philadelphia, Pa.
Harbison-Walker Refractories Co., Pittsburg, Pa.
McLeod & Henry Co., Troy, N. Y.

FIRE CLAY.
Harbison-Walker Refractories Co., Pittsburg, Pa.

FITTINGS, FLANGE AND PIPE.
American District Steam Co., Lockport, N. Y.
Direct Separator Co., Syracuse.
Goulds Mfg. Co., Seneca Falls, N. Y.
Kroeschell Bros. Co., Chicago, Ill.
Lunkenheimer Co., The, Cincinnati, Ohio.
National Tube Co., Pittsburg, Pa.
Pittsburg Valve Foundry and Construction Co., Pittsburg.
Richardson-Phenix Co., "Union Cinch."
Walworth Mfg. Co., Boston, Mass.
Williams Valve Co., D. T., Cincinnati, O.

FLANGES, CAST AND MALLEABLE.
Direct Separator Co., Syracuse.
National Tube Co., Pittsburg, Pa.

FLOATS.
Anderson Co., The V. D., Cleveland, Ohio.
Reliance Gauge Column Co., Cleveland, O.

FLUE CLEANERS.
Bayer Soot Blower System, St. Louis, Mo.
Claflin & Co., Chas. A., Boston, Mass. "Comet."
"Diamond" Power Specialty Co., Detroit, Mich. "Diamond."
Johns-Manville Co., H. W., New York.
Lagonda Mfg. Co., Springfield, O.
Marion Machine Foundry & Supply Co., Marion, Ind.
Monarch Steam Blower Co., Troy, N. Y.
Pierce Co., The Wm. B., Buffalo, N. Y. "Dean."
Stewart Heater Co., Buffalo, N. Y.

FLUE GAS ANALYSIS OUTFIT.
Pierce Co., The Wm. B., Buffalo,

FURNACES.
Harbison-Walker Refractories Co., Pittsburg, Pa.
Hawley Down Draft Furnace Co., Chicago, Ill.
McClave-Brooks Co., Scranton, Pa.
McKenzie Furnace Co., Chicago,
Sauer Power Generating Co., Inc., Pittsburg, Pa.
Wilkinson Foundry & Mfg. Co., Bridgeport, Pa.

FURNACES, OIL.
Petroleum Iron Works Co., Sharon, Pa. "Gem."

GASKETS.
American-Goetze Gasket & Packing Co., New Brunswick, N. J.
Canfield Mfg. Co., Philadelphia, Pa. "Ambest."
Carpenter & Co., Geo. B., Chicago.
Greene, Tweed & Co., New York. "Palmetto."
Jenkins Bros., New York. "96."
Johns-Manville Co., H. W., New York.
McCord Mfg. Co., Detroit, Mich.
Mechanical Rubber Co., Cleveland, Ohio. "Marco."
N. Y. Belting & Packing Co., Ltd., New York.
Peerless Rubber Mfg. Co., New York.
Quaker City Rubber Co., Philadelphia. "P. P. P.," "Ebonite."
Smooth-On Mfg. Co., Jersey City,

GASOLINES.
Penn Oil and Supply Co., Oil City, Pa.

GAS PRODUCERS.
De La Vergne Machine Co., New York, N. Y.
Otto Gas Engine Works, Philadelphia, Pa.
Sauer Power Generating Co., Inc., Pittsburg, Pa.
Westinghouse Machine Co., Pittsburg, Pa.

GAUGES, PRESSURE.
Ashton Valve Co., Boston, Mass.
Ashcroft Mfg. Co., The, New York, N. Y.
Bristol Co., The, Waterbury, Conn.
Ohio Injector Co., Wadsworth, O.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."

GAUGES, RECORDING.
Ashcroft Mfg. Co., The, New York,
Ashton Valve Co., Boston, Mass.
Bristol Co., The, Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
Ohio Blower Co., The, Cleveland,
Williams Valve Co., D. T., Cincinnati, O.

GAUGES, WATER.
American Injector Co., Detroit,
Ashcroft Mfg. Co., The, New York, N. Y.
Detroit Lubricator Co., Detroit,
Huyette Co., The Paul B., Philadelphia, Pa. "P. B. H."
Jenkins Bros., New York. "Grabber."
Jerguson Mfg. Co., Boston, Mass. "Reflex."
Lunkenheimer Co., The, Cincinnati, Ohio.
Ohio Blower Co., The, Cleveland, Ohio.
Ohio Brass Co., The, Mansfield, Ohio.
Ohio Injector Co., Wadsworth, O.
Penberthy Injector Co., Detroit, Mich.
Powell Co., Wm., Cincinnati, O.
Reliance Gauge Column Co., Cleveland, O.
Williams Valve Co., D T., Cincinnati, O.

GAUGES, WHEEL PRESS.
Ashcroft Mfg. Co., The, New York, N. Y.

GAUGE BOARDS.
Ashcroft Mfg. Co., The, New York.
Bristol Co., The, Waterbury, Conn.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."

GAUGE COCKS.
American Injector Co., Detroit.
Ashcroft Mfg. Co., The, New York, N. Y.
Chaplin Fulton Mfg. Co., Pittsburg, Pa. "Bingham."
Detroit Lubricator Co., Detroit.
Huyette Co., The Paul B., Philadelphia Pa. "P. B. H."
Jerguson Mfg. Co., Boston, Mass. "Wiltbonco."
Jenkins Bros., New York.
Lunkenheimer Co., The, Cincinnati, Ohio.
Ohio Blower Co., The, Cleveland.
Ohio Brass Co., The, Mansfield, Ohio.
Penberthy Injector Co., Detroit.
Powell Co., The Wm., Cincinnati.
Reliance Gauge Column Co., Cleveland, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."
Williams Valve Co., D. T., Cincinnati, O.
Wright Mfg. Co., Detroit, Mich.

GAUGE GLASSES.
Ashcroft Mfg. Co., The, New York, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio.
Peerless Rubber Mfg. Co., New York.
Quaker City Rubber Co., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."
Williams Valve Co., D. T., Cincinnati, O.

GAUGE TESTERS.
Ashcroft Mfg. Co., The, New York, N. Y.
Ashton Valve Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."

GEARS AND PINIONS.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Sauer Power Generating Co., Inc., Pittsburg, Pa.

GENERATING SETS.
American Engine Co., Bound Brook, N. J.
Fort Wayne Electric Works, Fort Wayne, Ind. "Wood Systems."
General Electric Co., Schenectady, N. Y. "G. E."
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

GOVERNORS, PUMP.
Chaplin-Fulton Mfg. Co., Pittsburg, Pa. "Fulton."
Davis Regulator Co., G. M., Chicago, Ill.
Dean Bros., Steam Pump Works, Indianapolis, Ind.
d'Este Co., Julian, Boston, Mass.
Foster Engineering Co., Newark.
Kitts Mfg. Co., Oswego, N. Y.
Monash-Younker Co., Chicago, Ill.
"S-C" Regulator Co, The, Fostoria, Ohio.
Squires Co., The C. E., Cleveland.
Strong, Carlisle & Hammond Co., Cleveland, O.
Williams Gauge Co., Pittsburg.

GRAPHITE.
Acheson Graphite Co., International, Niagara Falls, N. Y
Dixon Crucible Co., Jos., Jersey City, N. J. "Ticonderoga."

GRAPHITED GREASES.
Acheson Graphite Co., International, Niagara Falls, N. Y "Gredag."
Dixon Crucible Co., Jos., Jersey City, N. J.

GRATES.
Hawley Down Draft Furnace Co., Chicago, Ill.
McClave-Brooks Co., Scranton, Pa.
Under-Feed Stoker Co., Chicago, Ill. "Jones."
Wickes Boiler Co., Saginaw, Mich.

GREASE.
Penn Oil and Supply Co., Oil City, Pa.
Cooks Sons, Adam, N. Y. "Albany."
Keystone Lubricating Co., Philadelphia, Pa.
Penn Oil and Supply Co., Oil City, Pa.

GREASE CUPS.
(See oil and grease cups.)

HEATING AND VENTILATING DEVICES.
Ohio Blower Co., Cleveland, O.
Sturtevant Co., B. F., Hyde Park, Mass.

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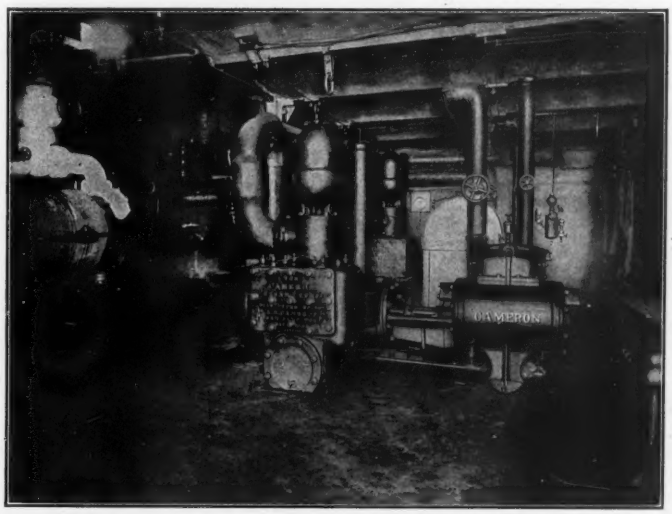
CAMERON PUMPS

Give Permanent Satisfaction

Engineers who want a pump for certain work should select the best; one of well known quality and reputation, that can be depended upon to render efficient service at the least expense. The superiority of the **CAMERON Pump** has enabled it to survive the keenest competition for 50 years, as it is in a class by itself.



In the engine room of H. Koehler & Co., brewery, 29th street and First Avenue, New York. CAMERON PUMPS, size 14x12x20, supplying salt water from East River to condensers, 1,000 feet suction pipe; maximum suction lift equivalent to 29 feet at low tide. They replaced Duplex pumps that could NOT do the work.

CAMERON PUMPS are simple in design, have no outside working parts, and are carefully constructed of the very best material, thereby insuring maximum strength and durability. They succeed when others fail, as they meet the demands imposed upon them, and are especially noted for their reliability in emergency service.

Cameron Catalog, Edition "F," illustrates and describes all types of Cameron Pumps. Sent on request to interested pump users and intending purchasers.

A. S. Cameron Steam Pump Works

Foot of E. 23rd Street, New York

Dec.

Classified Directory of Power Plant Apparatus and Supplies—Continued

HEATERS, HOT WATER SERVICE.
Alberger Condenser Co., New York.

HOISTS, ASH.
Jeffrey Mfg. Co., The, Columbus, Ohio.

HOISTS.
Brown Hoisting Mach. Co., The, Cleveland, Ohio.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York, N. Y.

HOISTS, ELECTRIC.
Brown Hoisting Mach. Co., The, Cleveland, Ohio.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

HOSE, ARMORED.
Sprague Electric Co., New York.

HOSE.
Carpenter & Co., Geo. B., Chicago. "Peerless Perfected."
Claflin & Co., Chas. A., Boston.
Greene, Tweed & Co., New York.
N. Y. Belting & Packing Co., Ltd., New York.
Peerless Rubber Mfg. Co., New York. "Perfected."
Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa.
Quaker City Rubber Co., Philadelphia, Pa.

HOSE FITTINGS AND MENDERS.
Claflin & Co., Chas. A., Boston, Mass. "Sure-Hold."

INDICATORS, ENGINE.
Asheroft Mfg. Co., The, New York, N. Y.
Indicator Instruction Co., Newark, N. J.
Lippincott Steam Specialty & Supply Co., Newark, N. J.
Robertson & Sons, James L., New York. "Robertson-Thompson."
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."

INDICATORS, SPEED.
Greene, Tweed & Co., New York.
Starrett Co., L. S., Athol, Mass.

INJECTORS AND INSPIRATORS.
American Injector Co., Detroit.
Hancock Inspirator Co., The, New York, N. Y.
Hayden & Derby Mfg. Co., The, New York, N. Y.
Jenkins Bros., New York. "Sellers."
Lunkenheimer Co., Cincinnati, O.
Ohio Injector Co., Wadsworth, O. "Garfield."
Penberthy Injector Co., Detroit.
Powell Co., The Wm., Cincinnati.

INSTRUMENTS, MATHEMATICAL.
Keuffel & Esser Co., Hoboken, N. J.
Starrett Co., L. S., Athol, Mass.

INSULATION.
Johns-Manville Co., H. W., New York.

JOINTS, EXPANSION.
Alberger Condenser Co., New York.
National Tube Co., Pittsburg, Pa.
Powell Co., The Wm., Cincinnati.
Walworth Mfg. Co., Boston, Mass. "Walmanco."

LAMPS, INCANDESCENT.
General Electric Co., Schenectady, N. Y.
Shelby Electric Co., Shelby, Ohio. "Masda Arc."
Johns-Manville Co., H. W., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

LAMP GUARDS.
McGill Mfg. Co., Valparaiso, Ind. "Loxon."

LIGHTING SYSTEMS.
Fort Wayne Electric Works, Fort Wayne, Ind. "Wood Systems."
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. Mfg. Co., Pittsburg, Pa.

LOCOMOTIVES, ELECTRIC.
Jeffrey Mfg. Co., The, Columbus, Ohio

LUBRICANTS.
Acheson Graphite Co., International, Niagara Falls, N. Y. "Acheson Graphite, Grade 1240."
Albany Lubricating Co., New York.
Cook's Sons, Adam, New York. "Albany Grease."
Dearborn Drug & Chemical Works, Chicago, Ill.
Dixon Crucible Co., Jersey City.
Keystone Lubricating Co., Philadelphia, Pa.
Penn Oil and Supply Co., Oil City, Pa.
Standard Oil Co., Inc., New York.
Steel Mill Packing Co., Detroit.
Stephenson Mfg. Co., Albany.
United States Mica Co., Chicago. "Mica Flakes."

LUBRICATORS.
American Injector Co., Detroit.
Cook's Sons, Adam, New York.
Detroit Lubricator Co., Detroit.
Essex Brass Co., G. B., Detroit.
Keystone Lubricating Co., Philadelphia, Pa.
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N. Y.
McCord Mfg. Co., Detroit, Mich.
Ohio Injector Co., Wadsworth, O.
Powell Co., The Wm., Cincinnati, Ohio. "Trojan."
Richardson-Phenix Co., The., Milwaukee, Wis.
Stephenson Mfg. Co., Albany.
Universal Lubricator Co., Philadelphia, Pa.
Williams Valve Co., D. T., Cincinnati, O.

LUBRICATORS, FORCE FEED.
Richardson-Phenix Co., The, Milwaukee, Wis.

MACHINERY EXHIBIT.
Philadelphia Bourse, Philadelphia.

MACHINERY, ICE AND REFRIGERATING.
De La Vergne Machine Co., New York, N. Y.
York Mfg. Co., York, Pa.

MACHINERY POWER TRANSMITTING.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Platt Iron Works Co., Dayton,

MACHINES, VALVE RESEATING.
Lagonda Mfg. Co., Springfield, O.
Leavitt Machine Co., Orange, Mass.

MECHANICAL DRAFT APPARATUS.
Green Fuel Economizer Co., The, Matteawan, N. Y.
Sauer Power Generating Co., Inc., Pittsburg, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

METALS, BABBITT.
Allen & Son, A., New York.
Magnolia Metal Co., New York.
Strong, Carlisle & Hammond Co., Cleveland, O.

METALLIC TUBING.
Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa.

MILL EQUIPMENT, OIL.
Platt Iron Works Co., Dayton,

MOTORS.
Allis-Chalmers Co., Milwaukee.
American Engine Co., Bound Brook, N. J.
Fort Wayne Electric Works, Fort Wayne, Ind. "Wood Systems."
General Electric Co., Schenectady, N. Y. "G. E."
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric Mfg. Co., Pittsburg, Pa.

OILERS.
Detroit Lubricator Co., Detroit.
Essex Brass Co., G. B., Detroit.
Lunkenheimer Co., Cincinnati, O. "Trojan."
Manzel Bros. Co., Buffalo, N. Y.
McCord Mfg. Co., Detroit, Mich.
Sterling Lubricator Co., Rochester, N. Y.
Williams Valve Co., D. T., Cincinnati, O.

OIL AND GREASE CUPS.
American Injector Co., Detroit.
Cook's Sons, Adam, New York. "Albany."
Detroit Lubricator Co., Detroit.
Essex Brass Co., G. B., Detroit.
Keystone Lubricating Co., Philadelphia, Pa.
Lunkenheimer Co., Cincinnati, O.
Ohio Injector Co., Wadsworth, O.
Penberthy Injector Co., Detroit.
Powell Co., The Wm., Cincinnati, O.
Universal Lubricator Co., Philadelphia, Pa.
Williams Valve Co., D. T., Cincinnati, O.

OIL RESERVOIRS.
Richardson-Phenix Co., The, Milwaukee, Wis.

OIL TANKS.
Burt Mfg. Co., Akron, O.
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N. Y.
Richardson-Phenix Co., The, Milwaukee, Wis.
Wright Mfg. Co., Detroit, Mich.

OILING SYSTEMS.
Richardson-Phenix Co., The, Milwaukee, Wis.

PACKINGS.
Allan & Son, A., New York. "Allan Metal."
American Goetze-Gasket & Packing Co., New Brunswick, N. J.
American Huhn Metallic Packing Co., New York, N. Y.
Canfield Mfg. Co., Philadelphia, Pa. "Ambert."
Carpenter & Co., Geo. B., Chicago. "Rainbow," "Peerless," "Eclipse."
Everybody's Packing Co., Philadelphia, Pa.
Eureka Packing Co., New York.
Federal Metallic Packing Co.
France Packing Co., Inc., Tacony, Pa.
Greene, Tweed & Co., New York. "Palmetto."
Holmes Metallic Packing Co., Wilkes Barre, Pa.
Jenkins Bros., New York. "Jenkins '96."
Johns-Manville Co., H. W., New York.
McCord Mfg. Co., Detroit, Mich.
Mechanical Rubber Co., Cleveland, O. "Marco." "Karbonite." "Ruby Red."
N. Y. Belting & Packing Co., Ltd., New York. "Karbonite."
Peerless Rubber Mfg. Co., New York. "Rainbow." "Eclipse."
Quaker City Rubber Co., Philadelphia. "Ebonite," "P. P. P."
Robertson & Sons, Jas. L., New York. "Eureka."
Smooth-On Mfg. Co., Jersey City.
Steel Mill Packing Co., Detroit, Mich. "Safety."
Thermoid Rubber Co., Trenton, N. J. "Solaroid."
Vanda Co., The, New York.

PIPE BENDING.
National Pipe Bending Co., New Haven, Conn.
Pittsburg Valve Fdy. & Construction Co., Pittsburg, Pa.
Walworth Mfg. Co., Boston, Mass.

PIPE COILS, IRON AND BRASS.
National Pipe Bending Co., New Haven, Conn.

PIPE COVERINGS.
Johns-Manville Co., H. W., New York.

PIPE CUTTERS.
Armstrong Mfg. Co., Bridgeport.
Ashcroft Mfg. Co., The, New York, N. Y.
Curtis & Curtis Co., Bridgeport, Conn. "Forbes."
Toledo Pipe Threading Mach. Co., The, Toledo, Ohio.
Williams & Co., J. H., Brooklyn.

PIPE, HIGH PRESSURE.
Kellogg Co., The M. W., New York, N. Y.

PIPE THREADING MACHINES.
Armstrong Mfg. Co., Bridgeport.
Borden Co., Warren O. "Solid-Adjustable."
Curtis & Curtis Co., Bridgeport, Conn. "Forbes."
Toledo Pipe Threading Mach. Co., The, Toledo, Ohio.
Williams & Co., J. H., Brooklyn.
Williams Tool Co., Erie, Pa.

PIPE, WOOD.
American District Steam Co., Lockport, N. Y. "Standard."

PIPE, WROUGHT IRON AND STEEL.
National Tube Co., Pittsburg, Pa.

PLANIMETERS.
Ashcroft Mfg. Co., The, New York, N. Y.
Ashton Valve Co., Boston, Mass.
Lippincott Steam Specialty & Supply Co., Newark, N. J.
Robertson & Sons, Jas. L., New York. "Willis."
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."

PRESSES, FILTER.
Platt Iron Works Co., Dayton,

PRESSURE REGULATORS.
Davis Regulator Co., G. M., Chicago.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
d'Este Co., Julian, Boston. "Curtis."
Foster Engineering Co., Newark.
Monash-Younker Co., Chicago, Ill.
Ohio Brass Co., The, Mansfield, Ohio.
Robertson & Sons, Jas. L., New York.
Squires Co., The C. E., Cleveland.
Strong, Carlisle & Hammond Co., Cleveland, O.
Watson & McDaniel Co., Philadelphia. "McDaniel."

PULLEYS.
American Pulley Co., Philadelphia.
Columbian Rope Co., Auburn, N. Y.
Jeffrey Mfg. Co., The, Columbus, Ohio.

PULLEYS, FRICTION CLUTCH.
Jeffrey Mfg. Co., The, Columbus, Ohio.

PULVERIZERS, COAL.
Jeffrey Mfg. Co., The, Columbus, Ohio.

PUMPS.
Alberger Pump Co., New York.
American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, O.
Du Bois Iron Works, Du Bois, Pa.
Goulds Mfg. Co., Seneca Falls, N. Y.
Lunkenheimer Co., Cincinnati, O.
Morris Machine Wks., Baldwinsville, N. Y.
Otto Gas Engine Works, Philadelphia, Pa.
Stewart Heater Co., Buffalo, N. Y.

PUMPS, BOILER FEED.
Alberger Pump Co., New York.
American Steam Pump Co., Battle Creek, Mich. "American."
Cameron Steam Pump Works, A. S., New York, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Goulds Mfg. Co., Seneca Falls, N. Y.
Terry Steam Turbine Co., The, Hartford, Conn.

PUMPS, CENTRIFUGAL.
Alberger Pump Co., New York.
De Laval Steam Turbine Co., Trenton, N. J.
Emerson Steam Pump Co., The, Goulds Mfg. Co., Seneca Falls.
Morris Machine Wks., Baldwinsville, N. Y.
Terry Steam Turbine Co., The, Hartford, Conn.

PUMPS, COMPOUND.
American Steam Pump Co., Battle Creek, Mich. "American."
Cameron Steam Pump Works, New York.
Dean Bros. Steam Pump Works, Indianapolis, Ind.

PUMPS, CONDENSATION.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
Cameron Steam Pump Works, A. S., New York.

PUMPS, DEEP WELL.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Deming Co., The, Salem, Ohio.
Du Bois Iron Works, Du Bois, Pa.
Goulds Mfg. Co., Seneca, Falls, N. Y.

PUMPS, ELEVATOR.
American Steam Pump Co., Battle Creek, Mich. "American."
Cameron Steam Pump Works, A. S., New York.
Goulds Mfg. Co., Seneca Falls.

PUMPS, FIRE.
American Steam Pump Co., Battle Creek, Mich. "American."
Cameron Steam Pump Works, A. S., New York.

PUMPS, FORCE FEED.
Richardson-Phenix Co., The, Milwaukee, Wis.

PUMPS, GRAPHITE.
Richardson-Phenix Co., The, Milwaukee, Wis.

PUMPS, GREASE.
Richardson-Phenix Co., The, Milwaukee, Wis.

PUMPS, HYDRAULIC PRESSURE.
American Steam Pump Co., Battle Creek, Mich. "American."
Cameron Steam Pump Works, A. S., New York.
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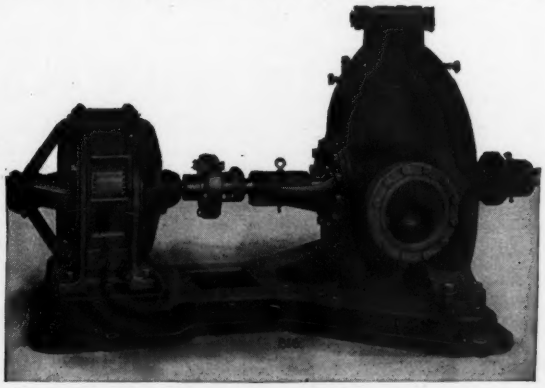

Fig. No. 218—No. 10 Single Stage Turbine Pump, on Bed Plate, with Direct Connected Motor

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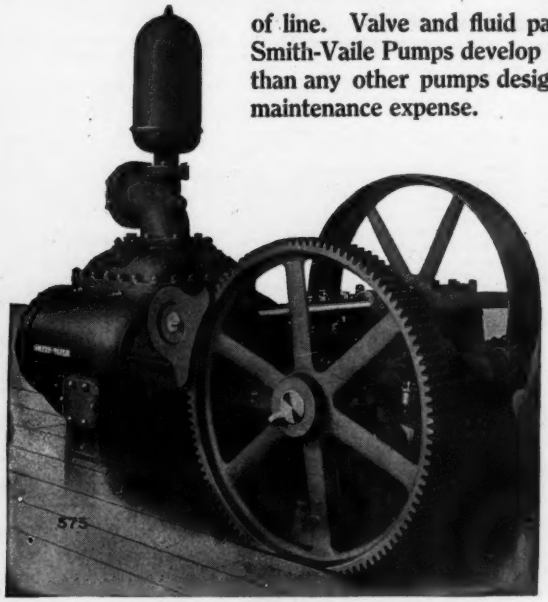

Fig. No. 70—Smith-Vaile Duplex Power Pump

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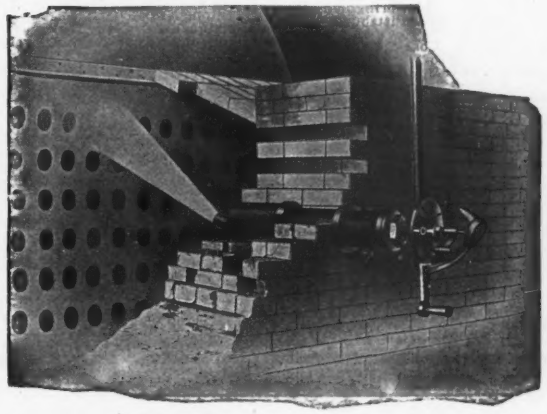

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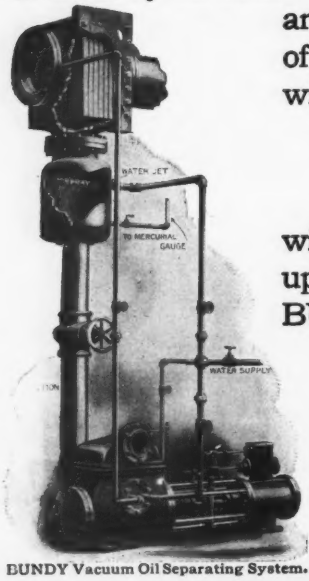

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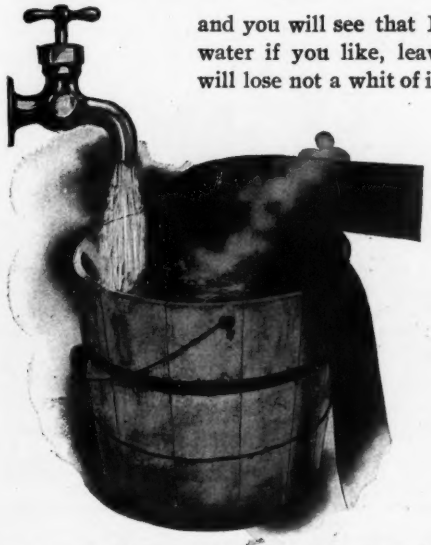

and you will see that Duxbak is not only **waterproof** but is **steam-proof.** Put it in **salt** water if you like, leave it out for a week in a snow storm; the result is the same—Duxbak will lose not a whit of its pulling power, nor a minute of its life. Duxbak is not "almost" waterproof—it's **entirely** waterproof. It isn't "pretty near" steam-proof. It's **wholly** so. It isn't "just as good." It's **better**—a **lot** better.

We Prove Duxbak's Superiority With a Trial Belt

We send you a Duxbak belt on trial—whatever size and ply you require—with a guarantee that saddles every cent's worth of risk and responsibility on **us. You** take no chance whatever. The Duxbak trade-mark stamped at every tenth foot of Duxbak Belting, is a demand note on us for every cent of the purchase price during the period covered by our guarantee. Send for a copy of the Duxbak Guarantee today and see how it binds us at every point. Then you'll begin to appreciate what it means to **you** to use belting that can be sold, and that **stays** sold, under such a guarantee.

Chas. A. Schieren Company
ESTABLISHED 1868

Tanners
Belt Manufacturers

Brooklyn, Cor. 13th St. and Third Ave.
Boston, 641-643 Atlantic Ave.
Pittsburg, 240 Third Ave.
Chicago, 84-86-88 Franklin St.
Philadelphia, 226 North 3rd St.
Denver, 1752 Arapahoe St.
Hamburg, Germany, Auf dem Sande 1
Bristol, Tenn., Oak Leather Tanneries

DUXBAK BELTING TRADE MARK

31 Ferry Street, New York City

Handling Coal and Ashes with an Electric Triplex Hoist on an Overhead Track.

The Overhead Way

WITH an Electric Triplex Hoist swung from a trolley one man can handle more coal and ashes in a day than by any other method. A pull on the switch enables him to lift a load that he never could handle by hand.

He can then push it to its destination—something he also could never do with the same load on a truck or barrow.

The Electric Triplex Hoist has effected the greatest revolution in load lifting and moving since the wheel was first invented.

We have a book about Electric Hoists which we should like very much to send you. All we ask is your name on a postcard.

Chain Blocks
4 Styles: Differential, Duplex, Triplex, Electric.
42 Sizes: One-eighth of a ton to forty tons.
300 Active Stocks: Ready for instant call all over the U. S.

The Book of Hoists tells much—for a postcard.

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Makers of Yale Products
Locks, Padlocks, Builders' Hardware
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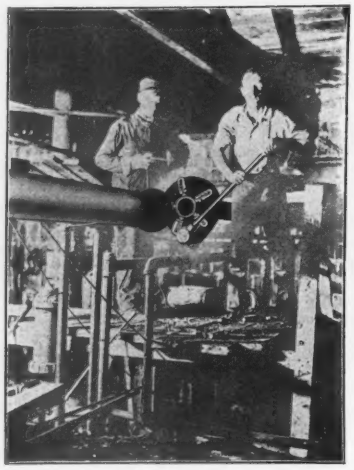
9 Murray Street
New York

Local Offices: Chicago, Boston, Washington, San Francisco

Canadian Warehouses: The Canadian Fairbanks Co., Ltd., Montreal, Toronto, St. John, N. B., Winnipeg, Calgary, Vancouver.



Getting The Expert's O. K.

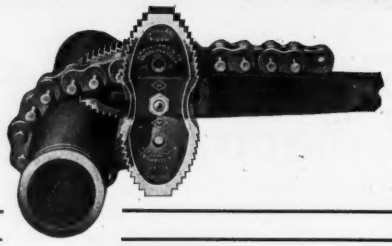
"If there is anything the matter with a 'Toledo' I don't know what it is."

This is an extract from a letter of the Chief Engineer of the Wisconsin State Tuberculosis Sanatorium.

It shows how expert engineers consider the "Toledo" line.

We can help you with your pipe threading troubles if you will ask for our booklet, "One Man Does the Work of Two."

The Toledo Pipe Threading Machine Co.
Toledo, Ohio



Eternal
"Vulcan-Bijaws"

There is no set of men who better appreciate the "take-down" points of machinery and tools than an engineer. It's the digestion of the pudding.

Williams particularly qualifies on these lines. Everything fit and a fitting for everything is the "Vulcan" slogan and you are moreover assured almost eternal service of an otherwise exceeding strong offering:

Double ended reversible jaws mean two in one at the price of one.

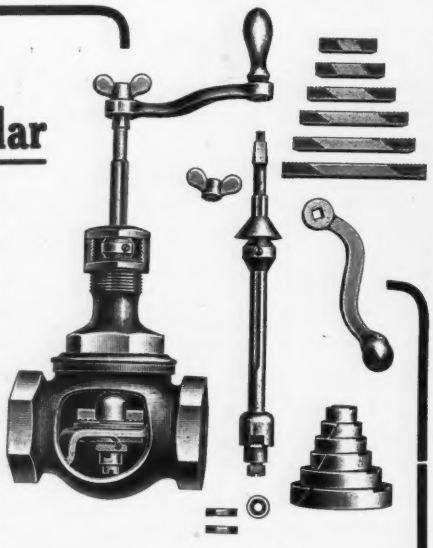
Two bolt jaw construction means preparation for emergencies—one bolt has full operating strength of tool.

Central swing of chain means "tool always right side up."

Price and discount from the dealer.

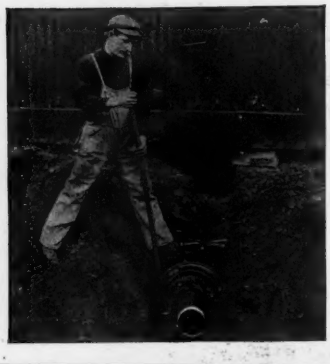
J. H. Williams & Co.
SUPERIOR DROP-FORGINGS
81 Richards St. Brooklyn, N. Y.

Be Particular



about the valve reseating device you buy—just as particular as you are about the valves—it's equally important and means a big saving if you select the right one at t start. With the **Nold Reseating Tool** an ordinary mechanic can recut a worn valve without disconnecting it from pipe line. The job is completed in a few minutes. The **Nold** is different—distinctly different from other reseating devices. The cutting tools, for instance, need only be reversed and they will cut taper or flat valve seats. A series of removable bushing rings, which are adjustable to any size valve, guide the lower end of tool so there can be but one result—a perfectly true seat. Send for literature. It's of particular importance to all valve users.

FRANK NOLD
500 Frazer Street - - BAY CITY, MICHIGAN



A Small Compact Pipe Cutting and Threading Machine

A machine that you can use as a hand machine, take right out on the job, whether it happens to be in a trench or on a scaffold.

Catalog tells how

THE
Curtis & Curtis Co.
53 Garden Street
BRIDGEPORT, CONN.

¶ Protection from loss by *breakage* or *theft* means a big reduction in your lamp bills.

The Best Way **LOXON LAMP GUARD** THE KEY TO SAFETY The Sure Way

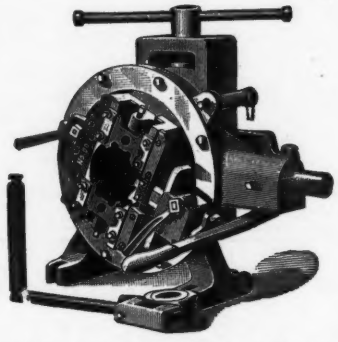
¶ You get the full candle hours from each lamp, and employes have no fear of accidental breakage, thus insuring greater freedom and efficiency in their work.

¶ Strongly built of the best materials, and will stand years of service. Write for a free sample on your firm's letter head.

McGILL MFG. CO., 33 Oak Street, Valparaiso, Ind.

No. "00" Pipe Threading Machine

For Hand and Power.



This machine cuts off and threads pipe from 1 inch to 4 inches. Using the **genuine** Armstrong Quick Opening Dies and Automatic Cut Off.

Power Attachment and Countershaft can be furnished to make it a power Machine.

Catalog sent on request.

THE ARMSTRONG MFG. CO.,
320 Knowlton Street, Bridgeport, Conn.
Chicago Office: 39 N. Jefferson Street.

JEFFREY COAL AND ASHES HANDLING EQUIPMENTS

Eliminates the elements of drudgery and waste energy

Illustration here shows Jeffrey Ashes Bin and Bucket Conveyor; the latter receives the ashes as it passes through the basement, under the boiler room and hoppers and delivers the ashes to the bin.

Other Illustrations in Jeffrey Catalog 32 Pf.

THE JEFFREY MFG. COMPANY
COLUMBUS, - - - OHIO

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IDEAL

Use The Ideal Wrench with the double faced jaws.

Grips Everything, Pipe, Round and Square Beaded Fittings

Send us trial order direct or through your jobber.

WANTED:—Pipe Fitters, Plumbers, Steamfitters and Engineers to send us their names and address, and we will mail to each one two very useful cards.

Kroeschell Bros. Co.
466 West Erie St. Chicago

The Double-Faced Jaws Can Be Attached to Any Handle

WRENCH

IDEAL WRENCH

"BEAVER" DIE STOCKS

Adjustable No Changing Dies

One Set of Dies Cuts all Sizes

Narrow Receding Dies

One Man Cuts Any Size

Made in All Sizes

Look them over the next time you visit your Supply house, or

Write for our illustrated Catalog.

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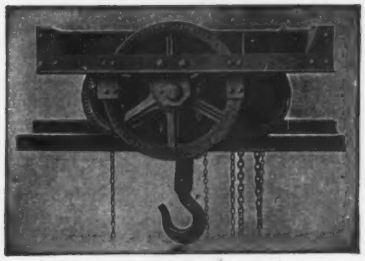
"BROWNHOIST" HAND-TRAVELING CRANES FOR POWER PLANTS, FACTORIES, ETC.

The illustration shows you the Top-running type for traveling on parallel T-Rails with Triplex Hoist built in. Special wheels are furnished for I-Beam track. Hoisting and traveling are by pendent hand chains from the floor.

The trolley frames are of structural steel shapes of sufficient strength to withstand severest strains. They cannot and will not become "sprung." The axles which turn with the wheels run in self-adjusting roller bearings and on both sides of the wheels and these bearings run in steel bushings. This construction insures easy operation to an extent that enables one man to move a tremendous weight with ease and rapidity.

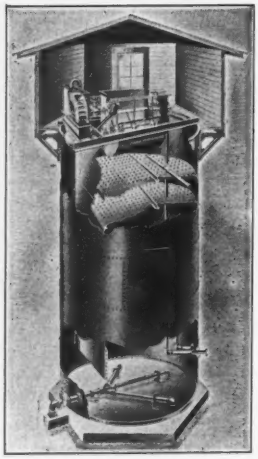
For handling fuel and heavy machinery in power plants and for many other purposes which immediately present themselves to your mind this hand-traveling crane is especially adapted.

Write for full information and illustrated bulletin.



The Brown Hoisting Machinery Co., Office and Works:— CLEVELAND, OHIO
Pittsburg, Frick Bldg. New York, 50 Church St.

NORTHERN
WATER SOFTENER



Why not have the best Water Softener made?

Costs no more in the beginning.

Costs less in the end.

Besides being far more satisfactory.

Built to last forever.

If *you* want soft water, write

NORTHERN WATER SOFTENER CO.

MADISON, WISCONSIN CHICAGO, ILLINOIS

Guaranteed For Double Belt Service

The "American" Steel Split Pulley is competent for any duty not so severe as to demand a special pulley. Its STRENGTH and LIGHTNESS (about half the weight—size for size—of a cast iron pulley) commend it to all users of power.

Patented

"AMERICAN"
Steel Split Pulleys

are made in sizes 6-inch to 60-inch diameter; 2-inch to 36-inch face. Sold by supply houses throughout the world. Catalog free.

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MAIN OFFICE & WORKS PHILADELPHIA, U.S.A.

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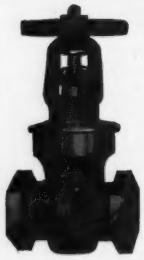


High Pressure Valves

We do not ask you to rely on our claim of superiority, but refer you to present users and remind you that each valve bears our guarantee to give satisfaction in material, workmanship and design.

Monarch Valve & Mfg. Co.,

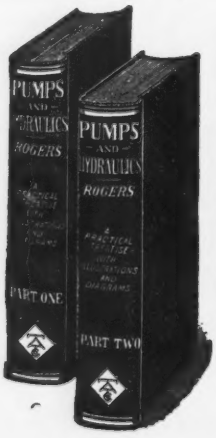
Springfield, Mass.

Factory, Warren, Mass. New York Office, 39 Cortlandt St.

Boston Office. 55 Batterymarch St.

It will pay you to have a permanent exhibit of your Machinery or Mechanical Appliances in the Exhibition Dept. of **The Philadelphia Bourse.** 18,000 square feet of machinery can be shown in operation. If interested, let us send you further particulars as to Space, Rates, etc. Address

The BOURSE, EXHIBITION DEPT. PHILADELPHIA.



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¶ These two volumes written so you can understand contain practical information on the construction, care and management of all types of **Pumps and Pumping Machinery,** also explaining the complete science of hydraulics and hydraulic machinery.

¶ Gives full instructions in valve setting and also a mine of up-to-date valuable information for engineers, superintendents, firemen and all men in charge of Power Plants.

¶ Contain **900 Pages, 700 Illustrations and Diagrams.** Handsomely bound and printed. Price $4.00, express prepaid. $1 monthly.

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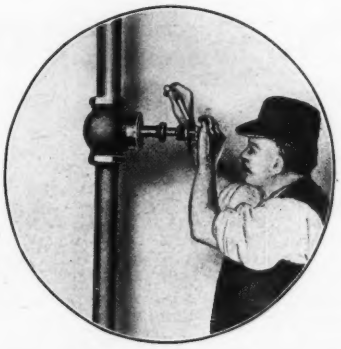
Where Employed.....



YOUR OLD VALVES WILL "COME BACK"

out of the dark corners and the scrap heap if you'll give them a chance. They'll come back and serve you as well as ever

IF YOU'LL RESEAT THEM WITH THE DEXTER VALVE RESEATING MACHINE

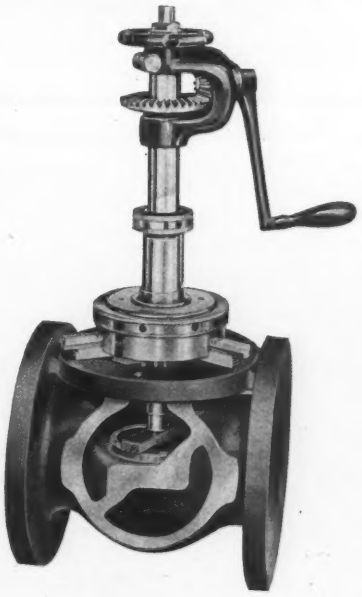
And the valves that are now in "the line" can be kept there and kept tight if you'll use the Dexter Machine on them whenever they show a leak; which you can do, mind you, RIGHT WHERE THEY STAND and IN A FEW MINUTES.

And just to SHOW YOU (or anybody else with a proper credit rating) that it will do what we say it will—

WE'LL SEND YOU A DEXTER VALVE RESEATING MACHINE ON 30 DAYS' TRIAL

You can make it save at least half its cost in that time, and then you can keep it or not—as you please.

Send for Catalog T. It will show you how to save money and shake trouble.



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ORANGE, MASSACHUSETTS

"COLUMBIA"
RECORDING THERMOMETER
WITH MERCURY FILLED

STEEL CONNECTING TUBE
AND STEEL SPRING
UNIFORM GRADUATIONS

The use of mercury in thermometers other than glass thermometers is a new departure in thermometer making.

Mercury Filled Steel Capillary Tube Thermometers are made by us only. They are better, stronger and more reliable than any other recording thermometer in existence.

GET SAMPLE CHART AND PAMPHLET "C."

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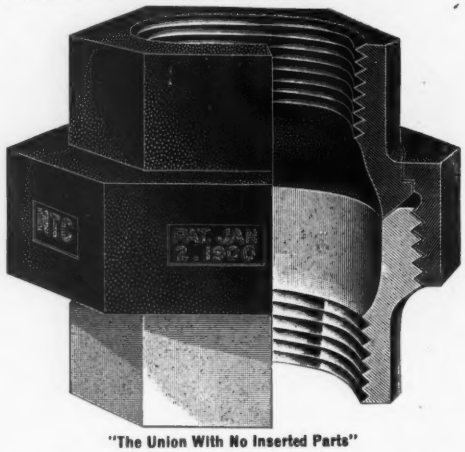
CHICAGO, 315 Dearborn Street :: :: PITTSBURG, Frick Building Annex

THE STRONG POINT IN **"KEWANEE" UNIONS**
is the brass to iron thread connection.



"The Union With No Inserted Parts"

Joints made up with "Kewanee" Unions are always easily broken, because the threads cannot corrode or stick together. "Kewanee" Unions are rapidly displacing other types in all sorts of power plants.

We have recently issued a booklet about "Kewanee" Fittings, entitled THE WHOLE KEWANEE FAMILY. We will send you one if you ask for it.

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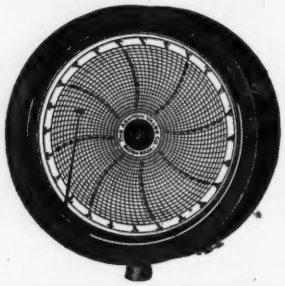
ASHTON
Improved Pressure and Vacuum Gages

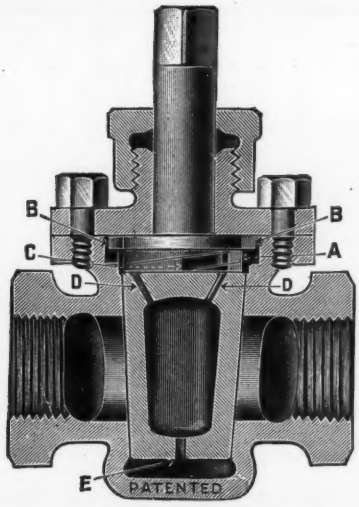


You will find them to be superior in quality, durability and accuracy. Every dial is marked up separately and accurately to match exactly the mechanism of the gage on which it is used. Springs are well seasoned, movements are of solid construction and non-corrosive.

A Catalog of Ashton Specialties is waiting for your address—Send it.

THE ASHTON VALVE CO.

271 Franklin Street BOSTON, MASS.



Homestead Valves

are at the top of the ladder —above all others

These valves are so perfectly constructed that the most vital parts are safe from the action of the pressure. They can not be equaled for service on feed-water lines, or in the handling of high pressure steam, air, gas or hydraulic work.

Leakage is positively prevented by our patented locking cam. When the valve is closed, this unfailing device forces the plug to the seat and holds it there perfectly tight. In opening, the cam releases the plug and allows it to turn easily.

Right here is where **Homestead Valves** fully demonstrate their extreme ease of operation—just a simple quarter turn is sufficient to open or close them. The groove on top of the stem indicates at a glance whether the valve is open or closed.

We have a catalog for you and it's a mighty good one. It describes our Straight-way, Three-way and Four-way Valves in full detail. Send for it now—your pencilled address on a postal is all that is necessary.

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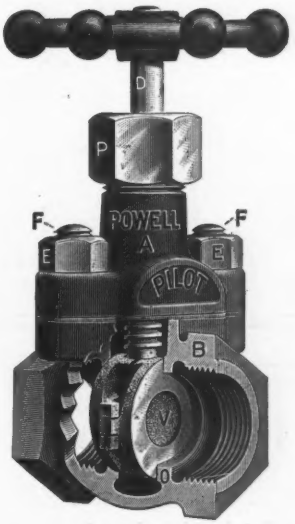
P. O. Box 1754, Piltsburg
WORKS: HOMESTEAD, PA.

For the control of sulphite solutions there is no better cheap valve than the

POWELL All Iron "Pilot" Double Disc Gate Valve



The DOUBLE DISCS are MADE ADJUSTABLE by the ball and socket back and are hung in recesses to the collar on the lower end of the stem, and fit snugly in the tapering seats of the body.

The double discs can be taken out and refaced whenever necessary—thus making a new valve.

May we send you the "Pilot" Circular?

Specify POWELL to your jobber and be sure of always getting what you ask for.

The name POWELL is cast on every article of Powell manufacture—Look for it.

THE WM. POWELL CO.
DEPENDABLE ENGINEERING SPECIALTIES.
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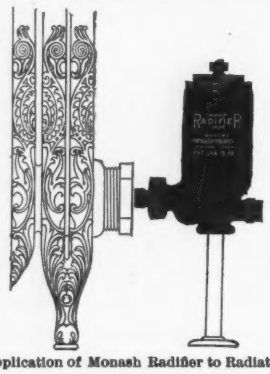

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Wanted—Your name and address

FOR FULL PARTICULARS REGARDING THE

MONASH NOISELESS SYSTEM OF VACUUM HEATING

Can be installed by any engineer **without payment of royalty.** Nothing contributes more to the efficiency of a **Vacuum System** than a perfect valve on the return end of the steam heating unit. The **MONASH RADIFIER VALVE** is the outcome of years of specializing in steam heating devices.

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THE ERWOOD SWING GATE VALVE

The **only valve** to use on the **exhaust connection** of an Engine—**Preventing** the Cylinder from **filling** with condensation from other units. Water cannot **back up** through the Exhaust Valves—Saving Possible **wrecking** where Open Heaters overflow and Pressure Heaters **leak back** into the Cylinder. Exhaust connections Open Heaters, Receiving Tanks, Cookers, and other Exhaust apparatus **cannot be burst** where the **"ERWOOD VALVE"** is used. A valve that **operates in any position.** No plant is complete without it. Send for catalog.

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For Positions or Help,
Second-Hand Machinery,
Wanted or For Sale,
use the
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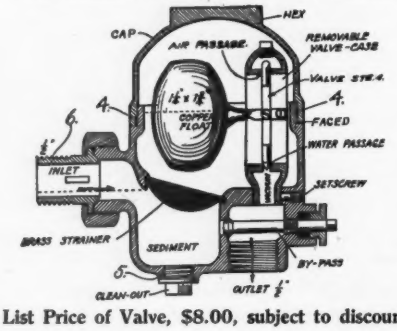
Practical Engineer

Rochester Vacuum Valves

Absolutely Noiseless in Operation



List Price of Valve, $8.00, subject to discount.

This cut shows our No. 2 Horizontal type valve. *Dirt* has no terrors for this valve. It will work *first, last,* and *all the time.*

Notice the *balanced valve;* the *large strainer case,* containing 12 sq. in. of *strainer area.*

The *seamless copper float* will stand 200 lbs. pressure and *not collapse.* In a *vacuum system* it is seldom subjected to more than 5 lbs. pressure. We guarantee it for 5 years service.

Write for circulars.

Rochester Vacuum Valve Co.

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Sauer Power Generating Co.

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Steam Heating System — **Ventilating System**

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Largest MANUFACTURERS of REFRIGERATING & ICE MACHINERY in the world

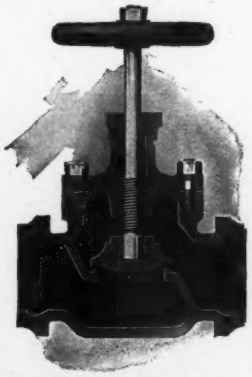
Ammonia Fittings

Are The Best

that it is possible to make, and owing to the special melting and annealing furnaces with which our foundry is equipped, are nearly double the tensile strength of those made in the ordinary way.

ALL OF OUR AMMONIA VALVES

are so constructed that when the stem is raised a sealed back seat is formed, thus enabling it to be readily repacked without shutting down or pumping out. See Sectional View herewith shown.



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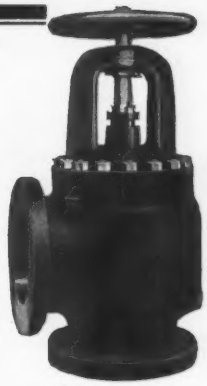
PITTSBURG	Greenwood Const. & Sup. Co.	337 Water Street
BUFFALO	Wegner Machine Co.	Perry and Miss. Streets
CLEVELAND	Cleveland Ice Machine Co.	
CINCINNATI	Queen City Supply Co.	Elm and Pearl Streets
ST. LOUIS	Pilsbry-Becker Eng. & Sup. Co.	200 North Main Street
CHICAGO	Westerlin & Campbell Co.	26-28 N. Clinton Street
ATLANTA	York Manufacturing Co.	13 South Forsyth Street
NEW ORLEANS	Chas. F. Rantz	736 Conti Street
HOUSTON	York Manufacturing Co.	710 Franklin Avenue
LOS ANGELES	United Iron Works	151 N. Los Angeles St.
OAKLAND	United Iron Works	2nd and Jefferson Sts.
SEATTLE	United Iron Works	508 First Ave., South
SPOKANE	United Iron Works	R. R. and Stevens St.
DENVER	Althoff Manufacturing Co.	

Foster Valves

"Reliability Their Main Feature"



Automatic Non-Return Stop Valve

IF you ever have the feeling of not being sure if a valve will work right when called upon, cut that valve out--better still; don't install that kind. We claim reliability as the main feature in all Foster Valves and it covers all else you want in a valve to reduce or regulate pressure--design, workmanship, material and operation.

Whatever the pressure reducing, pressure regulating service, you want a valve for--get a FOSTER.

If you are making any effort to secure better results around the plant GET A FOSTER, more efficiency, GET A FOSTER, greater safety, GET A FOSTER, increased economy, GET A FOSTER.

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Newark, New Jersey

Makers of high pressure regulators, low pressure regulators, back pressure regulators, pump governors, fan engine regulators, free exhaust valves, float valves, non-return stop valves, combination valves, etc.

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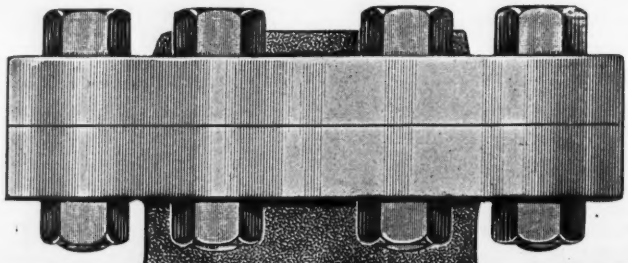
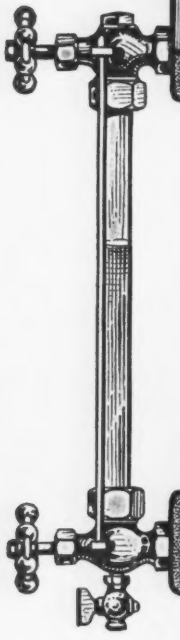


Is Your Engine Getting Dry Steam?

HAVE YOU any assurance that your engine is being protected from the dangerous slugs of water that are carried over into the cylinder, due to the foaming of boilers or long steam mains where there is considerable condensation? Water in the cylinder of your engine impairs its efficiency—it cuts the valves—scores the cylinders—interferes with lubrication—and most important, there is a constant danger of the cylinder head blowing out.

Why not avoid the issue by installing a

Cookson Steam Separator

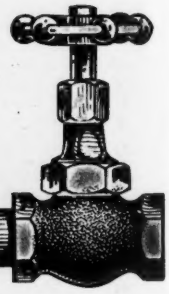


on the throttle of your engine? It will not only safe-guard your engine against accidents, but greatly increase its efficiency by furnishing a constant supply of dry steam containing less than 1% of moisture, without decreasing the pressure.

Of simple and compact construction, thoroughly efficient in operation, the Cookson Separator is bound to appeal to every engineer, because the economy and safety effected by its use will more than pay for the installation in a few months.

If your engine is without a separator, you should at once investigate and buy a Cookson.

The Williams Blue Book gives dimensions, prices and other details. We want you to have a copy. Write today.



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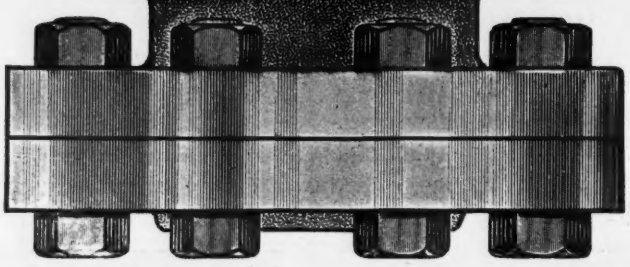

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Combined with the MOST IMPROVED DESIGN and HIGH GRADE WORKMANSHIP make

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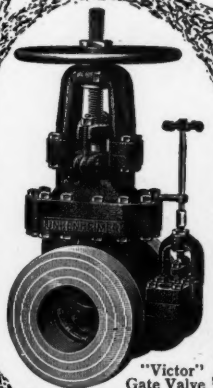
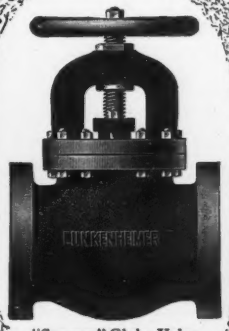
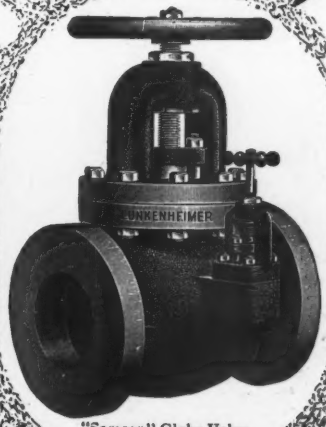
The leaders of their line. The iron used is made according to our own formula and has a tensile strength of 25,000 pounds per square inch. All parts subjected to wear are renewable and are made of a good grade of bronze composition containing a high percentage of copper and tin. The line consists of Globe, Angle, Cross, Check, and Gate Valves.


"Victor" Gate Valve Outside Screw and Yoke with By-Pass

"Victor" Gate Valve Stationary Stem without By-Pass



"Samson" Globe Valve without By-Pass



"Samson" Globe Valve with By-Pass

These valves are made in all standard sizes and in several weights, the heaviest being for working pressures up to 250 pounds.

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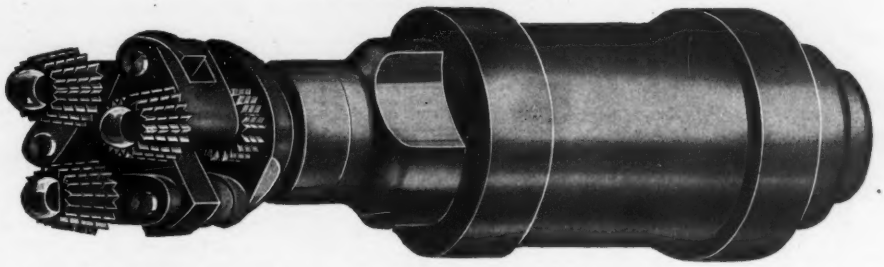
What's The BEST Way To Clean YOUR Boilers?

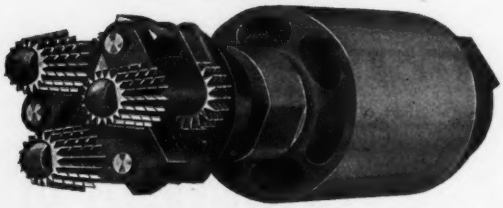
There are a dozen different ways of removing scale from boiler tubes. One way is best suited to your conditions, so don't feel satisfied with any cleaner. Look into the matter carefully. We mention below a few special cleaners you ought to know about.

Steam or Air?



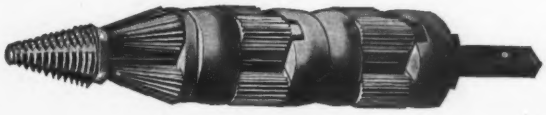
In plants where water is expensive or the pressure low, the above cleaner is the most economical to use. It operates satisfactorily on any air or steam pressure above 40 lbs. and will develop enough power to remove the hardest kind of scale. As it uses the Quick Repair Head we guarantee that every particle of scale will be removed and at the same time the tubes will not be injured.

Water?



Where water pressure is available the Weinland Ball-Bearing or Thrust-Bearing Cleaner will fill the bill satisfactorily. Due to the efficient construction of the turbine it will remove a larger amount of scale with a smaller consumption of water than any other turbine cleaner we know of. Write and ask us about competitive tests which prove this.

Power?



Where a large number of boilers have to be cleaned quickly the above cleaner is well suited. It can be belted to an electric motor, steam engine, or to available shafting. Or we can supply our special air or steam-driven external motor. This cleaner will remove the hardest and thickest kind of scale in the shortest space of time.

The cleaners mentioned above are only three of our 25 different styles. If one of the three isn't what you want, you will find the right one described in catalogue "K." Write for a copy.

The Lagonda Mfg. Co.
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NEW YORK, BOSTON, PHILADELPHIA, PITTSBURG, CHICAGO, DETROIT,

FUEL SAVING SPECIALISTS

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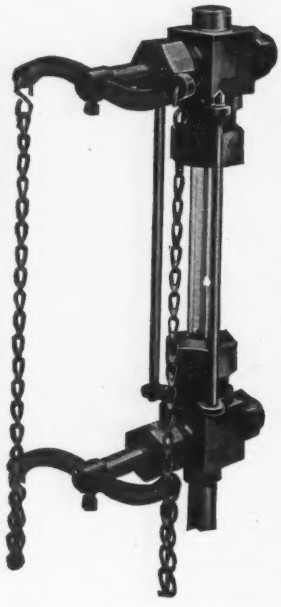
Makers of Weinland Boiler Tube Cleaners, Automatic Cut-Off Valves, Reseating Machines, Boiler Tube Cutters and Water Strainers



The "P. B. H." Quick-Closing Water Gauge

is an accident insurance against scalds and burns. If the glass breaks, a pull of the chain shuts off both the steam and water. Its structure is perfect; extra heavy body, best steam metal, with extra large nuts for extra heavy washers. Less than a quarter turn of stem fully closes or opens valves.

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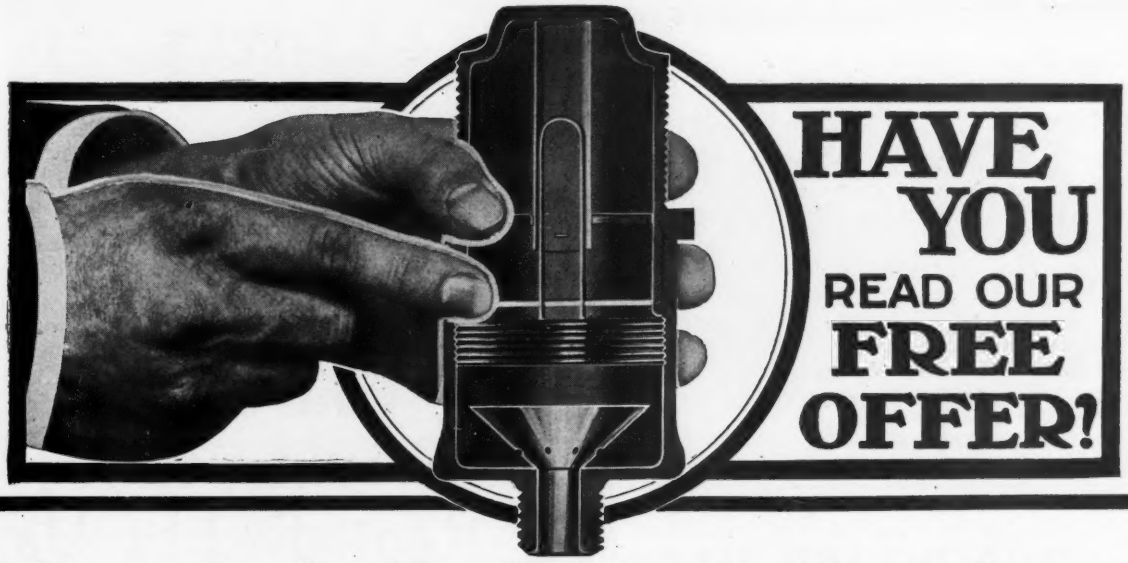

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If you were dead sure you were spending 33 1-3 to 50 per cent too much you wouldn't keep your present system two minutes—would you?

Now as proof that you are spending too much we'll go to all the expense of making 30 day comparative tests right in your plant between "Philadelphia" Grease Cups and your present system.

And this isn't any bluff.

We're doing it everywhere or anywhere in the country in this way:—

We'll install anywhere you specify—on your hardest job—one to one dozen "Philadelphia" Compressed Air Grease Cups and supply you free with sufficient of any of the leading greases on the market (named above) to last in the cups we install for 30 days use.

We repeat, we will do all this at no cost to you whatever, and if after 30 days you for any reason do not wish to keep the cups we will remove them at our expense and the 30 day trial has cost you nothing for cups or grease.

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NO! It is only because we are so absolutely sure of the remarkable saving of these little cups that we can afford such an offer.

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NOW—

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You have nothing to lose and everything to gain in a big reduction in your lubrication bills.

All we ask you to do is decide where you'd like us to make the test—note it on the coupon below together with the number and size of the cups,—then note the grease which you select from the following:—

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Philadelphia Grease, manufactured by Phila. Grease Co., Phila., Pa.

Then mail the coupon!

FREE SPIRIT LEVEL

As a further appreciation of your time we will send with the cups and grease **entirely free a nickle plated spirit level** which we have had specially made.

This cut is actual size, but cannot possibly illustrate its quality—which is the highest.

Now, will you do this at once—to-day? If you haven't grasped the real significance of this offer read over the above again—stop and consider what a sincere offer it is. Then fill in and mail the coupon below so if you're going to save any money on these "Philadelphia" Cups you can **get at it. Send us the coupon before you forget.**

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City .....
Number of cups desired .....
State on which bearing test will be made .....
Width ..... R.P.M. .....
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YOUR BOILER HAS A STRENUOUS TIME

even in a strong, healthy condition, but when scale begins to form and steadily grows thicker, requiring a hotter fire to heat through the scale and periodical shut-downs for cleaning, with its hammering and hacking, do you wonder that the service the boiler gives begins to waver—that the boiler itself begins to crack, bulge, sag and finally leak?

There's a cure for all this trouble—a tonic that will "tone-up" and keep the boiler in the best of health year after year. It is "Pyramid" Brand Compound.

Steam users all over the world are using it and keeping their boilers in excellent condition.

We have been making "Pyramid" Compound so long that new conditions don't bother us and we are more than a match for old ones.

Send us a sample of your scale and we'll make a thorough analysis. It costs you nothing.

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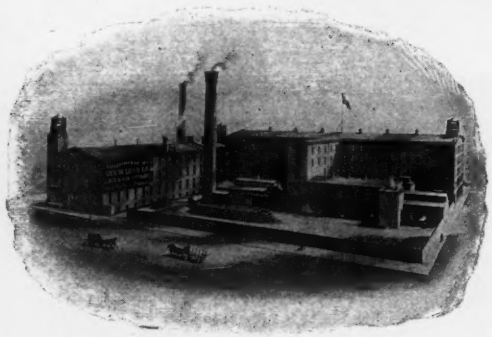

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At no expense on your part, we'll make an individual analysis of your feed water. Then, if you say so, we'll prepare a compound exactly suited to the particular requirements of **your scale** or feed water difficulties.

LORD'S Boiler Compounds

are world famous. They not only remove old deposits of scale, oil and grease, but they prevent new from forming. They stop pitting, grooving, foaming and corrosion. They soften and disintegrate the scale, yet cause positively no injury to the boiler.

If you're troubled with "pitting" or "corrosion" send us a sample of your feed water only for free analysis. Send sample of scale only if "scale" troubles you. (Use attached coupon, please.)

Free on Request A splendid book by Geo. W. Lord, founder of this firm, entitled, "Boiler Troubles and Their Treatment." 80 pages, brim full of boiler "troubles" information.

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Type of boiler.....

River or other source of water supply.....

Do you run day and night.....

Do you have trouble with foaming.....

Are you using a liquid compound.....

Name of firm.....

Address .....

City and State.....

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You Say Your Feed Water is Different

And that's right. Of course it is. That's why we insist on analyzing a gallon of feed-water from each customer's plant before filling his order for Boiler Compound.

It's just like taking a remedy put up according to the doctor's prescription, as compared with a patent medicine. Your case may be very much like a hundred others that the medicine man has treated successfully, but he knows that it isn't **exactly** like them, and that somewhere in the Pharmacopeia is the shade of difference in medicines that will meet that shade of difference between **your** case and the hundred others.

He knows that for quickest and best results you require individual, not "average" or "collective" treatment.

So he finds out **first,** just what's the matter with **you.** Then you get a made-for-you compound and are relieved or cured. It's the same way with us.

We Send You a Bird-Archer Made-For-You Boiler Compound That Will Do The Work

If through some condition not disclosed by the examination, the Bird-Archer Compound fails to clean your boilers of scale and keep them clean, then the Compound doesn't cost you a cent.

And there isn't anything in Bird-Archer Compounds that **can** do your tubes a nickel's worth of damage.

We've a book that was "made for you" too. It isn't merely an advertisement. It's just what it is labeled—a scientific treatise on "Boiler Troubles and Their Prevention." Tell us where to mail you a copy of this book.

THE BIRD-ARCHER CO., 90 West Street NEW YORK

A Dearborn Treatment Success in the Phillipines

The East Batan Coal Mines, on the Island of Batan in the Phillipines, have been using feed-water containing 52 grains of scaling salts to the gallon. Of course that's bad water to use, but it's the best obtainable on the Island of Batan.

Through our agents in Manila we took the matter in hand, and the accompanying photograph shows a direct result of Dearborn Treatment. The huge quantity of scale meant increased fuel consumption and a corresponding decrease in boiler efficiency.

In this instance Dearborn Treatment was first used for removing existing scale—and you can see the result. *Now* they use Dearborn Treatment for *preventing* scale formation, corrosion and other evils resulting to the boiler tubes and sheets, from the action of the water.

Our method of procedure was exactly the same as we apply in all instances; that is, we analyzed a sample of the feed-water and prepared treatment to suit conditions as revealed by the analysis. We discovered the exact nature of the mineral contents and the quantity in each gallon of the feed-water, then compounded a preparation containing reagents which neutralized the scale-forming salts in the feed-water, removed existing scale, and prevents further formation.

DEARBORN DRUG & CHEMICAL WORKS

ROBERT F. CARR, President

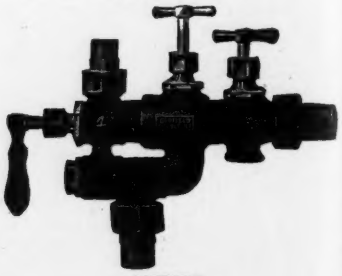
BRANCH OFFICES IN ALL PRINCIPAL CITIES 5

General Offices, Laboratories and Works, CHICAGO
General Eastern Offices, 299 Broadway, NEW YORK

Send us a gallon sample of the feed-water used in your boilers. We will analyze it and send suggestions for treatment, absolutely free of cost. Complete literature sent upon request.

SATISFACTION AND PERFECT SERVICE *are guaranteed when your outfit is equipped with a*

CHICAGO OR GARFIELD INJECTOR AND CHICAGO DOUBLE CONNECTION LUBRICATOR



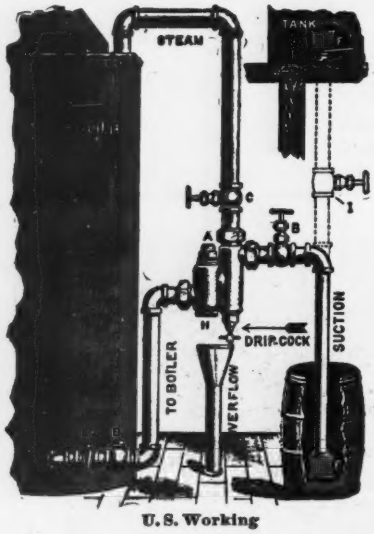
CHICAGO LUBRICATORS have the heating chamber cast into the body. This gives them over four times as much heating area as other makes which have a small brass tube for this purpose. The results are that CHICAGO LUBRICATORS feed heavier oils and will work when exposed to cold places. It will pay you to look into the merits of the CHICAGO. Ask your dealer about them, or write us for circular describing same.

We also manufacture the GARFIELD and CHICAGO INJECTORS for stationary and locomotive service. They have been adopted by over 125 of the large Railroad Companies in the U. S., and all large steam users.

Write us for further information.

THE OHIO INJECTOR COMPANY,

131 South Main St., WADSWORTH, OHIO, U. S. A.



U. S. Working

U. S. Automatic INJECTOR

Never fails to work when connected properly

EASY TO REPAIR
ALWAYS RELIABLE
SIMPLE TO OPERATE
EASY TO CONNECT

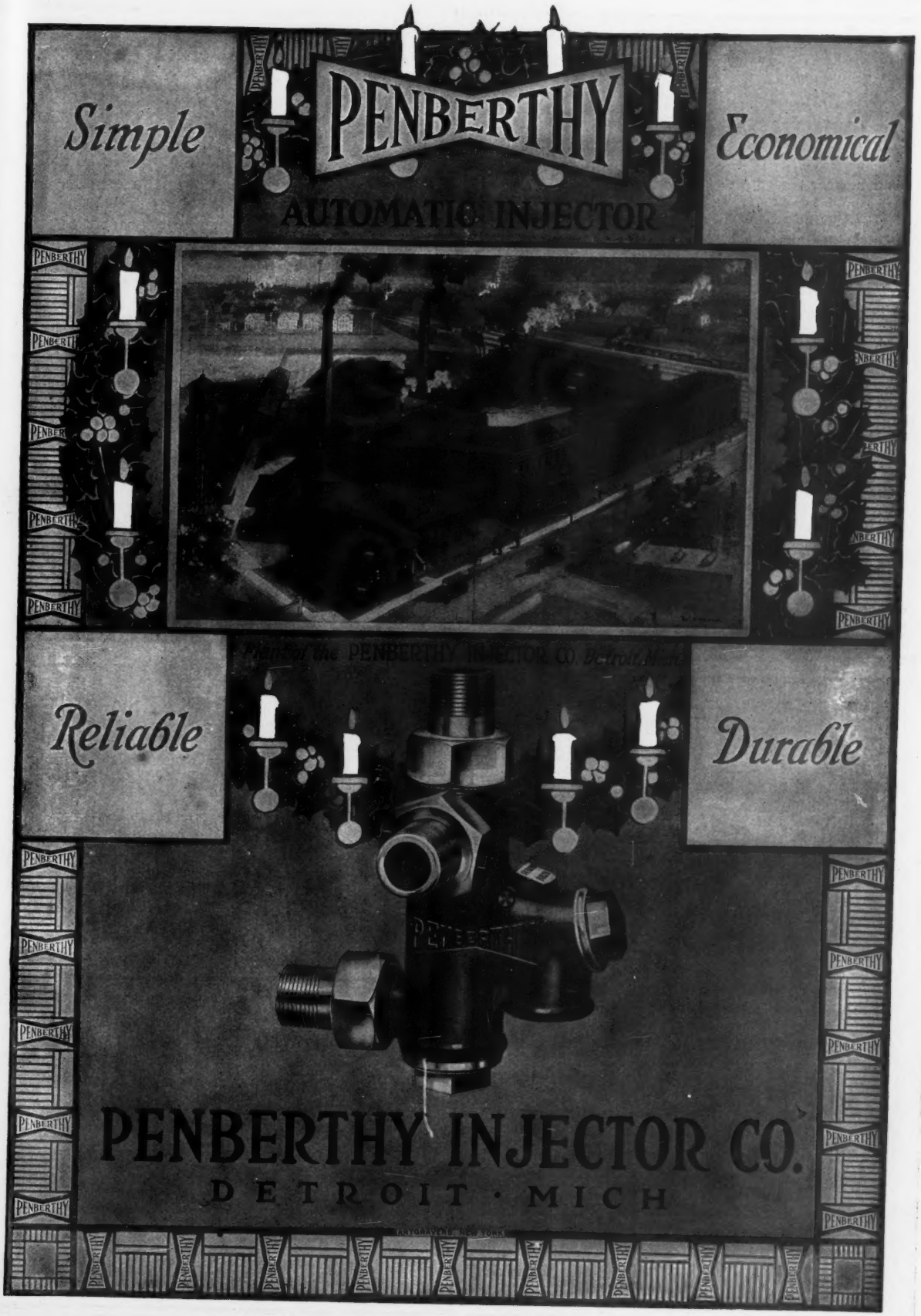
300,000 ENGINEERS have testified to its merits and declared it to be

The Best Boiler Feeder on the Market

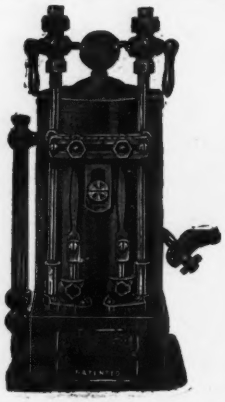
Write for our engineer's Red Book which contains 500 questions and answers, every engineer should know.

FREE FOR THE ASKING

AMERICAN INJECTOR COMPANY, :: :: :: DETROIT, MICH.


Simple
PENBERTHY
AUTOMATIC INJECTOR
Economical
Reliable
Durable
PENBERTHY INJECTOR CO.
DETROIT · MICH

We want to show you



right in your own plant and under your own supervision, that the Sterling Force Feed Lubricator will enable you to secure the best lubrication possible and at the same time reduce your oil bills from 40 to 60%.

So we are willing to send you a Sterling Lubricator for 30 days' free trial

Test it as thoroughly as you wish and we'll abide by your decision. If it doesn't cut down oil bills—make your machinery run smoother—eliminate uncertain feed—send it back and we'll not say a word.

At any rate, you ought to have our catalog. It's full of interesting data so write for it **NOW.**

STERLING LUBRICATOR COMPANY

5 Frank Street **Rochester, N. Y.**

Pittsburg Agent, H. H. Gilmore, 309 Curry Bldg., Pittsburg, Pa.
New York Agent, Wm. J. McAuslin, 136 Liberty St., New York

539 Styles of Detroit Lubricators

Because no **one** lubricator can be made to give proper service under **all** conditions, you will find in the Detroit line a lubricator for **every** condition.

You will find a Detroit Lubricator **exactly** suited to your requirements.

Every Detroit Lubricator is the product of scientific study of the service for which it is designed.

And 1,200,000 Detroit Lubricators are proving every day that each one is the right one for its particular place.

The Detroit Air Compressor Lubricator

is the latest addition to the big Detroit line. It is the result of careful study into the requirements of air compressor lubrication.

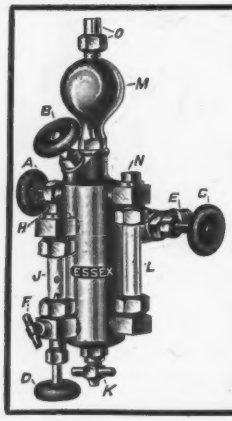
The Detroit Air Compressor Lubricator can be started and stopped without changing the feed adjustment. The permanent feed adjustment prevents bother and loss of time and oil when starting up.

The Detroit catalog tells all about it and describes the complete Detroit line. Write for catalog A-9.

DETROIT LUBRICATOR COMPANY,

DETROIT, U. S. A.

Largest Manufacturers of Lubricating Devices in the World.



FOR ENGINE LUBRICATION USE

ESSEX'S Standard Sight Feed Lubricator

For cylinder lubrication this type is superior in many ways, and is designed to meet the requirements of all classes of stationary service.

Built in sizes from one-third pint to one gallon oil capacity.

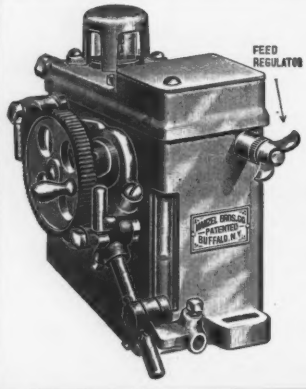
ESSEX'S Improved Journal Oiler

A simple and positive oiler that is always on the job. Like all other Essex Specialties, only the best materials are used in its making.

The Essex guarantee means more than quality—it insures satisfaction.

Ask your dealer or write us for literature and prices.

G. B. ESSEX BRASS COMPANY, Detroit, Michigan



The Manzel Sight Feed Oil Pump

Class "HA"

is absolutely positive under all conditions. It has double plungers—the lower plunger draws the oil out of the reservoir and forces it through the sight glass and the upper plunger forces it into the steam cylinder—the supply of oil being adjusted with the feed regulator. This arrangement insures positive lubrication under any and all conditions.

Write **today** for our catalog and learn of the many economical advantages derived from its service.

MANZEL BROS. CO.

327 Babcock Street **BUFFALO, N. Y.**

The Largest Office Building In The World

The Hudson Terminal Building, New York, has a complete power plant located 4 stories below the street level and all power units are equipped with the

Richardson
Model "M" Lubricator

"The Aristocrat Of All Lubricators."

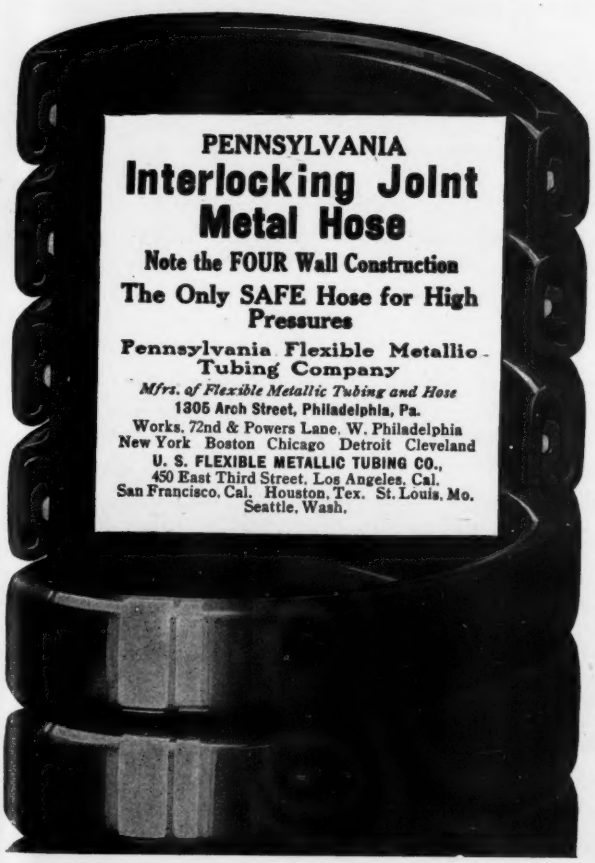
We are showing, week by week, the most convincing arguments in favor of any lubricating device—its installation in the country's finest and largest plants. Let us send you all the details. Ask for Catalog "W."

The Richardson - Phenix Co.

Works: Milwaukee, Wis.

"Everything For Lubrication But The Lubricants."
Largest manufacturers of oiling devices in the world.

Eastern Sales Office: Hudson Terminal Bldg., New York City
Western Sales Office: First National Bank Building, Chicago



PENNSYLVANIA
Interlocking Joint Metal Hose

Note the FOUR Wall Construction

The Only SAFE Hose for High Pressures

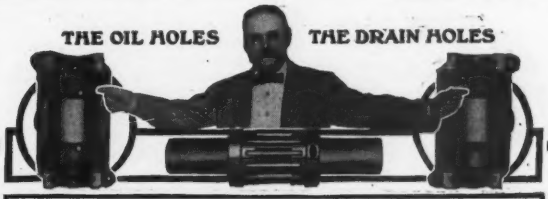
Pennsylvania Flexible Metallic Tubing Company

Mfrs. of Flexible Metallic Tubing and Hose

1305 Arch Street, Philadelphia, Pa.

Works, 72nd & Powers Lane, W. Philadelphia
New York Boston Chicago Detroit Cleveland

U. S. FLEXIBLE METALLIC TUBING CO.,
450 East Third Street, Los Angeles, Cal.
San Francisco, Cal. Houston, Tex. St. Louis, Mo.
Seattle, Wash.



SELLS ROLLER BEARINGS

TO CONVINCE YOU.

Just how perfect this construction is, and before telling you about the big features of these roller bearings—we want to talk about some small details that are often neglected.

Every Sells Roller Bearing Box is provided with tapped holes on the top in order that oil cups may be used.

They are also tapped with drain holes so that they may be flushed with kerosene oil or other cleansing fluid and thus cleaned should the oil get thick and gum.

These bearings are absolutely dust proof. The two halves are fitted together by means of milled joints and at each end is a felt wiper which serves the double purpose of preventing the dust from getting in and the oil from getting out of the box and dripping off the shaft.

They are 50 per cent cheaper than any other roller bearing and will save you 50 per cent to 65 per cent of your friction load. These are facts you can't get away from. Read this list of other advantages.

1. Can be fitted to every hanger, post hanger and pillow block in your plant without changing a single detail of your present equipment.
2. Universal in adaptation (any Sells Bearing can be fitted to any hanger, post hanger or pillow block of a corresponding size).
3. Split throughout, applied as easily as a split pulley.
4. Shaft is protected from all wear by steel split bushing.
5. Can be bushed to fit different diameters of shafts.
6. All end thrust is eliminated, (Sells is full floating type).
7. Has self contained roller structure eliminating all friction between rolls and insuring that rolls will run parallel with box at all times.
8. Sells has rotating surface against which ends of roller structure run.

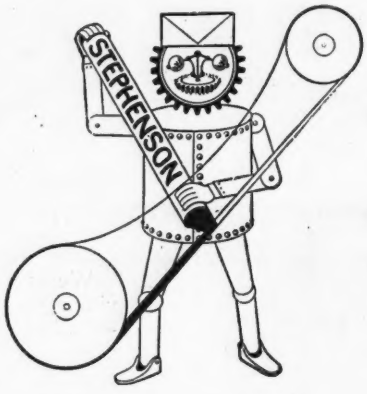
Now it's hard for anyone to fully appreciate the full meaning of these advantages and we haven't the space to fully explain them. That's why we are mighty anxious to have you send for our booklet and the facts that will give you the whole story.

So write now before it slips your mind.

Manufactured by ROYERSFORD FOUNDRY & MACHINE COMPANY, Inc.
Manufacturers of Power Transmission Machinery,
and Punching and Shearing Machines.
55 N. Fifth St., Philadelphia, Pa.
European Office: Theodore Butler, Ltd. 149 Queen Victoria St., London, E. C.

In This "Trade-Mark" You See a "Symbol" Which Stands For Reliable Goods and "The Square Deal."

RED LABEL BRAND
for use on
Leather Belts



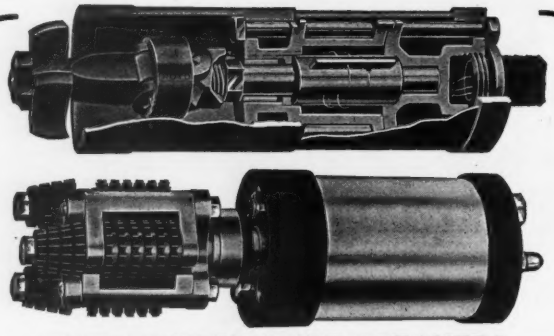
GREEN LABEL BRAND
for use on
Rubber, Canvas or Balata Belts

Trade-Mark Reg.

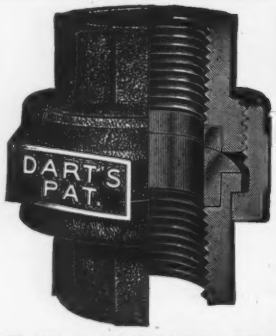
Look for this Trade-Mark on every bar of Stephenson Bar Belt Dressing. Then you are sure of getting the original "Standard of the World since 1888" Brand. *At all up-to-date dealers, and*

Stephenson Mfg. Co., - Albany, N. Y.

Trade-Mark Reg.



ROTO BOILER TUBE CLEANERS
Send for New Catalog
THE ROTO CO., Hartford, Conn.



Dart Union Coupling

Both pipe ends iron. Both seats bronze metal. The first insures strength. The second insures non-corrosion. No cored parts to weaken. No soft metal pipe end. Sample sent free.

E. M. DART MFG. COMPANY, Providence, R. I.
Canadian Factory: DART UNION CO., Ltd., Toronto.

Who Says Christmas?

This to remind you about it. Magazines make the best presents. Give your wife or children a magazine they will like to read, for Christmas.

You can have a complete catalog giving lowest prices for all magazines free.

Practical Engineer is included in many offers with other magazines at prices you will want to take advantage of.

Ask us to mail you one of these catalogs today--They are free. A post card will do it.

PRACTICAL ENGINEER
355 DEARBORN STREET, CHICAGO

KEYSTONE PRESSURE FILTER

There's as much difference between the Keystone Pressure Filters and others, as between Dollars and Cents,

for this reason:— Most any filter will prove a good investment in a plant troubled with muddy water—but the ***Keystone System*** not only removes the mud, but all dissolved impurities as well, keeping the boilers absolutely free from ***SCALE*** at a very small cost as compared with the cost of removing it after it gets in the boiler.

Tell us your troubles, we'll tell you what the investment will be to remedy them.—It may surprise you by it's modesty.

Sign this coupon and we'll send you two books that tell how to purify water at small cost.

Keystone Chemical Mfg. Co.
Pennsylvania Building
PHILADELPHIA, - - PENN.

Chicago, 648 First Nat'l Bank Bldg.
New York, 141 Broadway
San Francisco, 104 Front St.

SIGN THIS

COUPON

Gentlemen:—Send me your two books on water purification.

Name .....
Address .....
Employed by .....
H. P. of Boilers .....
Do they give trouble? .....

When A Bearing Gets Hot

up goes the temper and temperature of every individual around the plant and a hurry call is put in for the trouble man, who usually is the chief engineer.

You know what follows: stop the machinery, cool and clean out the bearing and a lot of other details, involving loss of time and labor, all of which could be saved by having

Mica Flake Lubricant

on hand for just such emergencies, or better still, to use with your oil or grease at all times.

MICA FLAKE insures you against all Hot bearing troubles and *will cool, while running, the worst case you have ever known.*

MICA FLAKE is a pure, unadulterated product of nature, procured from our own mines and ground by our special process into varying grades of fineness, each for its particular class of service.

MICA FLAKE possesses lubricating efficiency superior to Graphite or any other known product and will reduce your oil bills fully 40 per cent.

MICA FLAKE mixes readily with oil or grease.

Letters from hundreds of big and little concerns all over the country who use MICA FLAKE say they could not do without it. If their experiences interest you, write and let us know, but the best way is to test it on some particularly obstinate bearing in your own plant. You can do this at the cost of a postage stamp.

Fill out the attached coupon, or make a request on the firm's letterhead and we will mail you Free a sample of enough MICA FLAKE to thoroughly demonstrate that it will do more than any claim we make. Do this today and be free from Hot Box troubles, for you never will do without MICA FLAKE again.

TRY IT AND BE CONVINCED

Manufactured Exclusively by

THE UNITED STATES MICA CO.

238-240 La Salle Street, Chicago

United States Mica Co., 238 La Salle St., Chicago.

Send us by express, prepaid, 10 pounds of MICA FLAKE LUBRICANT on trial for 30 days. If satisfactory, we to remit $5.00, otherwise return it at your expense and our obligation ceases and no charge for amount used.

Name of firm.....

Address .....

This Belt Formerly Ran Tight and Kept the Engineer Busy All the Time. See How it Acts After Cling-Surface Treatment!

This 8 in. single ply leather belt runs from 22 in. driving to 30 in. driven pulley on 10 foot center and at a speed of 1350 ft. per min., carries irregular load up to 20 h.p. and is subjected to dampness.

Before using Cling-Surface the belt had to be run so tight that several fillings of the oil cups on the engine were required daily.

Now, since Cling-Surface is being used, the belt is pliable and clean, proof against dampness, carries full load without slip, ***runs with a sag of two feet,*** and the engine bearings remain cool with one filling of the oil cups per day.

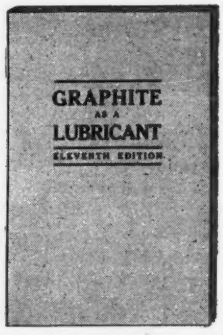
A belt properly treated with Cling-Surface and run slack will often break before slipping, never gathers dirt on the outside, is waterproof and rarely or never, needs tightening. Try Cling-Surface on one or two belts.

23

Cling-Surface Co

1028 Niagara Street **Buffalo N Y**

New York Boston Chicago Denver Atlanta Memphis Etc



Last Call For "Graphite as a Lubricant"

This is the last ad we shall run on our 11th edition of "Graphite as a Lubricant." If you didn't get a copy of this authoritative booklet, write now for it by Number 96-C.

JOSEPH DIXON CRUCIBLE CO.

JERSEY CITY, N. J.

When the Oil Man drops in for a friendly call, he knows you are nearly out of Oil and is looking for his regular monthly order. Does the clock-like regularity of his visits ever make you wonder where all this good oil goes to every month?

When the Acme Oil Filter makes a 30 day visit in your plant you will begin to see where a lot of this good oil was being wasted, and on the occasion of the Oil Man's next call you will surprise him by cutting the regular order of **three** barrels down to **two.**

ACME OIL FILTERS

are installed in all parts of the world, and in each and every instance they are fulfilling our guaranty.

Let us send you one on trial, to be put to any test you care to make, and if it fails to lessen the frequency of the Oil Man's visits or cut his usual order down, ship it back to us and no explanation will be required.

Walter L. Flower Co.

313 South Eighth St. **St. Louis, Mo.**

PENN BRAND

SCREW CUTTING COMPOUND

WORKS LIKE LARD OIL

COSTS ONE-TENTH AS MUCH

The Sign of Quality

A harmless oil that **mixes instantly with cold water,** without the use of an alkali, making a rich, creamy compound that is exceptionally **strong in cutting** properties.

Can be used for any class of machine work where **Lard Oil** is considered necessary.

It does **perfect** work.

Has no **offensive** odor.

Does not cake in the oil system or **separate** when allowed to stand.

Requires **only** the addition of water in the required proportion when it is ready for use.

DIRECTIONS.

For drilling and rough ordinary work, saw oil, etc., one gallon of oil to twelve of water.

For Sharpers, etc., one gallon of oil to ten of water.

For Milling, Thread-cutting and Automatic Machines, one gallon of oil to eight of water.

For extremely hard, fine work, use one gallon of oil to four of water.

When used in an oiling system on various classes of work a steady flow of a one to eight mixture will prove satisfactory.

Order it from your dealer. If he hasn't it, write us.

PENN OIL & SUPPLY CO. Ltd.

Minneapolis, Minn.
Sioux Falls, S. D.
Moorhead, Minn.
Chillicothe, Mo.
Rock Island, Ill.
Burlington, Ia.
Ottumwa, Ia.
Washington, Ia.

MAIN OFFICE AND WORKS:
OIL CITY, PA.

DOES it seem to need filling oftener than it should? Do you find it empty sometimes when you expect it to be half full? When you use

Capitol
Cylinder Oil

that same coffee-pot will prove the economy of CAPITOL and give the assurance that there is no waste. It won't need filling so often, for a little CAPITOL Cylinder Oil goes a long way. It's *all lubricant* — all effective—all good.

¶ It reduces friction to that minimum and saves all the wear and fuel of which the best cylinder oil is capable.

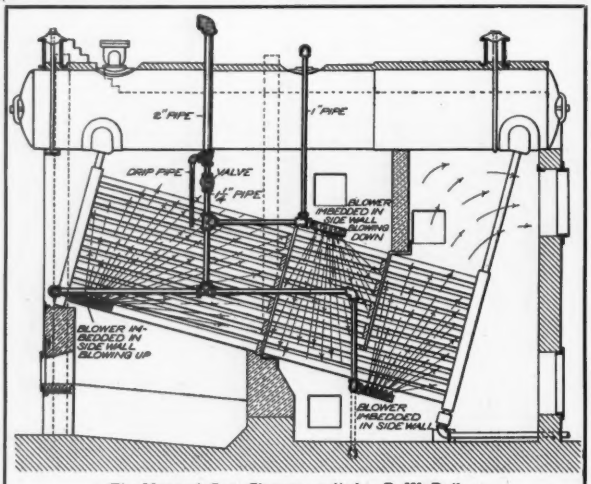
Renown
Engine Oil

is not a heavy stringy oil. It is light both in body and color.

¶ It makes its way into the closest bearings. *Renown* in its high efficiency for lubricating high speed engines and dynamos is in a class by itself.

Both Capitol Cylinder Oil and Renown Engine Oil are sold in barrels and half barrels.

Standard Oil Company
(Incorporated)



The Monarch Soot Cleaner applied to B. W. Boiler

Mr. Engineer do yon want to burn less fuel under your water tube boilers and avoid flue cleaning by hand? Write us now for full information on

MONARCH SOOT CLEANER FOR ALL TYPES OF WATER TUBE BOILERS

Reasonable in Price — Simple to Install
Operates by One Valve

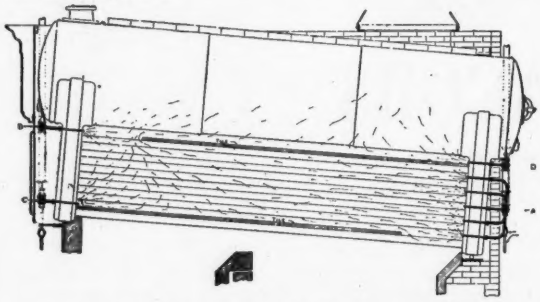
MONARCH STEAM BLOWER CO., Cor. River & State Streets, Troy, N. Y.

also Manufacturers of Monarch Flue Blower for Fire Tube Boilers

THE BAYER SOOT BLOWER SYSTEM

"Saves over $15.00 a week in fuel and labor in our plant," writes the Blish Milling Co, of Seymour, Ind.

Pays for itself and then pays a profit by keeping down running expenses.



Perhaps you like the dirty job of cleaning out soot by hand methods. Even if you do it's 10 to 1 your employer would be glad to see the coal pile last longer.

THE BAYER SYSTEM can be attached to any water-tube boiler without cutting holes in the setting or altering it in any way, and three minutes' time blows out all the soot.

A 30-DAY TRIAL is the most convincing salesman you ever met and you keep your money unless thoroughly satisfied. That's our way of doing business.

Some good literature with opinions of near-by users that will interest you will be mailed upon request. Write today.

Bayer Soot Blower System
206 Pine St. **St. Louis, Mo.**

No. 104

PRICE, POSTPAID, $1.00

Starrett Speed Indicator

This indicator may be run at highest speed required without heating. The working parts are encased. The dial has two rows of figures, reading either right or left as shaft may run. Has steel pointed spindle with rubber tips for both pointed and centered shafts. The (0) mark may be instantly set at the starting point. *Send for free Catalog 17-N., of Fine Tools*

THE L. S. STARRETT COMPANY,
ATHOL, MASS.

Starrett Tools

ALBANY GREASE

stays **where it's put and** ***does*** **what it's put there to do**

That's why the engineer who uses Albany Grease *knows* that he's lubricating—*knows* that his machinery is being lubricated as long as it runs—*knows* that when the machinery stops and the need for the lubricant no longer exists, the lubricant stops.

ALBANY GREASE IS ALL LUBRICANT—NO WASTE

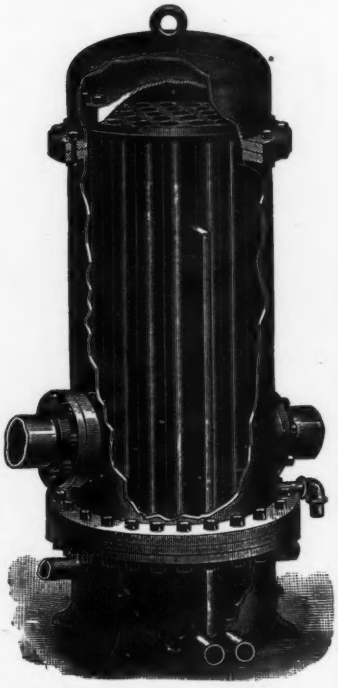
If you will send us pipe tap, depth of oil hole, name of firm and where used, we'll send you an Albany grease cup and enough ***Albany Grease, free,*** *to give it a good trial.*

ALBANY LUBRICATING COMPANY
Sole Makers
ADAM COOK'S SONS, *Proprietors* 313 West St., NEW YORK

You Will Never Be Troubled With Back Pressure in a

JACOBS

Patent Water Tube Feed-Water Heater



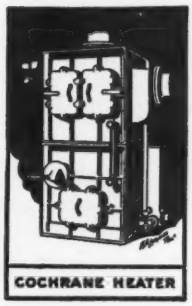
The chamber into which the exhaust steam goes has an area five times greater than the exhaust pipe. Many other advantages make it worthy of your attention.

Our Booklet fully describes them — send for it today.

CHAS. JACOBS & CO., 49 Oliver Street, BOSTON, MASS.

New York Office: W. A. KITTS, Jr., Mgr., 143 Liberty St. Room 101.

A HALF DOZEN MORE EXCELLENT REASONS FOR CHOOSING A COCHRANE HEATER



COCHRANE HEATER

I. A Cochrane Open Feed Water Heater liberates corrosive air and gases from the water, and precipitates scale forming matter.

II. A Cochrane Open Feed Water Heater is easily cleaned. Generally a shovel and a hose is all that is needed.

III. A Cochrane Open Feed Water Heater will improve the quality of any boiler feed water that forms scale, no matter how bad it is.

IV. A Cochrane Open Feed Water Heater is substantially built, cast iron, copper, brass and bronze throughout. No steel plate, no joints affected by expansion and contraction strains.

V. A Cochrane Open Feed Water Heater frequently pays for itself within three or six months, but big dividends always, and they last from twenty to thirty years.

VI. With every Cochrane Heater you obtain the advantage of all of our years of experience in designing, building and installing thousands of feed-water heaters—for the largest steam users—for every conceivable condition.

Write for a hundred more good reasons in Treatise on "Profitable Utilization of Exhaust Steam."

HARRISON SAFETY BOILER WORKS
3144 N. 17th St. Philadelphia, Pa.

SOOT HASN'T A CHANCE—

when you tackle it with the Marion Flue Blower. It is the most rapid and practical apparatus ever devised for keeping flues clean. No waste of time—no waste of energy and no dirt. Saves cost of steam hose and reduces fuel bills.

Try the Marion for Thirty Days Free.

If your boilers don't show increased steaming capacity—if your fuel bills don't show an appreciative reduction—if the Marion doesn't substantiate all our claims, send it back at our expense. We know what it can and will do in your plant and willingly take all risks in this wide-open proposition. Our catalog gives detailed information. Send for it today.

The Marion Machine, Foundry & Supply Co., Marion, Ind.

Next Month's Issue

of Practical Engineer will give you an unfailing recipe for ridding your boiler tubes of soot. It will pay you well and continuously to withhold any order you may anticipate placing for any soot-removing device until you've read the page advertisement appearing in this paper next month over the signature of

Yours truly Chas. A. Claflin & Co., 58 High Street, Boston, Mass.

OUR EASY PAYMENT PLAN

Permits you to pay for a heater out of the money it saves for you. After that the savings are clear profit.

Many people buy household furniture and luxuries on the "installment plan," why not apply it to the necessities of the steam plant?

If interested fill out and mail the attached coupon.

THE PATTERSON - BERRYMAN FEED WATER HEATER AND PURIFIER

is too well known to need description here. If not satisfactory, it costs you nothing. **You take no chance.**

FRANK L. PATTERSON & CO., 24 Cortlandt St., New York

FRANK L. PATTERSON & CO.,
24 Cortlandt St., New York.

Please send specifications and price, with trial offer and EASY PAYMENT PLAN on heater and purifier for the following duty:

Horse power of boilers?.....

Working pressure of boilers?.....

Diameter of exhaust pipe from engine?

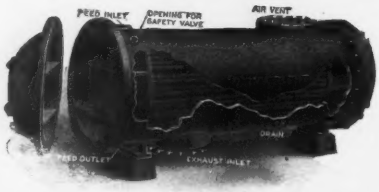
.....

NAME .....

ADDRESS .....

.....

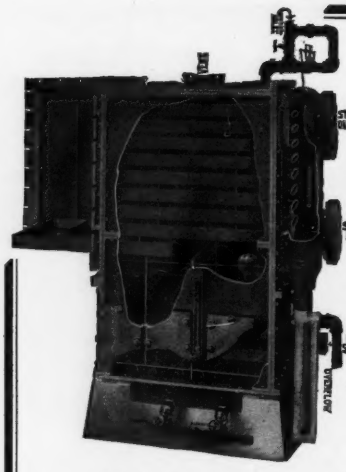
The Wainwright Heater



FEATURES AND ADVANTAGES

CORRUGATED TUBE	High Rate of Heat Transmission Freedom from Incrustation Accommodation of Expansion Within Tube
STRAIGHT TUBE	Ease of Cleaning Ease of Repair Compactness
COPPER TUBE	Freedom from Splitting Freedom from Pitting
LARGE WATER CHANNELS	Ease of Removal of Impurities

Alberger Condenser Company
140 Cedar Street, NEW YORK CITY
Pittsburg Chicago St. Louis San Francisco



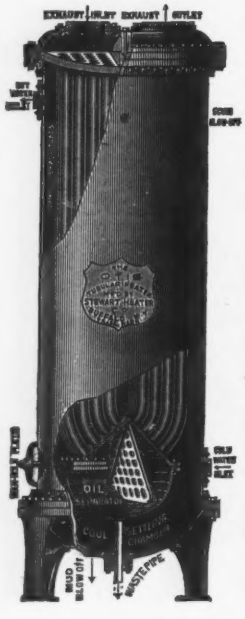
The Stickle Open Heater and Purifier

This is strictly an OPEN HEATER of the Tray Type. The words "Open Coil" are descriptive of the course the water takes over the tray surface.

This heater is easy to clean. Our catalog tells why.

Open Coil Heater & Purifier Co.
502 South Pennsylvania Street, Indianapolis, Indiana
Ask for descriptive catalogue, at the same time we will enclose you one of our Steam Trap catalogues, the most complete line in the market today.

WHAT DO YOU DO



when your feed water heater fills up with scale and grease and refuses to heat the feed water above 180 degrees or thereabouts? The constant loss of 30 degrees of heat is worth a great deal more to you than the cost of an

OTIS Feed Water Heater, Oil Separator and Purifier

which is the only heater that never fills up and which extracts the oil and grease from the exhaust.

Any heater will show results while new. The OTIS shows results all the time, because it is always clean as when new.

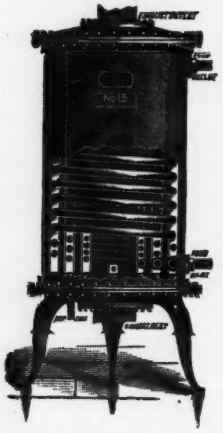
Note the deep separator at the bottom; no other heater has this feature and no other heater has ever equalled the OTIS in service.

Seamless drawn brass tubes that contract and expand independently of each other.

The only tubular heater with water separator, oil extractor and skimming pan.

Send for Catalog.

STEWART HEATER COMPANY
7 Norfolk Avenue, BUFFALO, N. Y.



YOU WON'T FAIL TO GET

PERFECT SERVICE

FROM A

NATIONAL FEED-WATER HEATER

It is the simplest heater made, yet the most effective one, because it has no inside joints to leak and the water does not come in contact with the shell or iron.

It absolutely insures against back pressure, grease in the boiler and waste of fuel.

We have a booklet on Feed Water Heating for you. Send us your address.

THE NATIONAL PIPE BENDING CO.,
157 Lloyd St., New Haven, Conn.

HOT FEED WATER

is the greatest economy you can effect. Waste heat from exhaust steam, put back into the boiler, at the saving of ten to twenty per cent of your coal bill, will pay for a Feed Water Heater in a few months.

REILLY Multicoil Feed Water HEATER

is a **multum in parvo** proposition—exceptionally large capacity and great heating efficiency in very small compass.

Those separate small coils of copper tubing keep the water hustling on its way and in **constant contact** with the heating surfaces.

The **outlet** water temperature of the Reilly Multicoil is the **inlet** feed temperature to the boiler.

Every one of those copper coils is secured by a **union**. "Every coil is a spring"—**its own expansion joint.** No strains—no leaks.

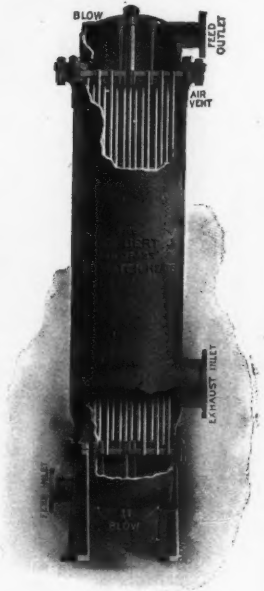
That big door in the side gives **instant access to every part,** on those rare occasions when repairs are needed.

Goubert Feed Water Heater

Will handle a flood of water, and heat it thoroughly, without noticeable back pressure — straight tubes and large cross-sectional areas are the reasons.

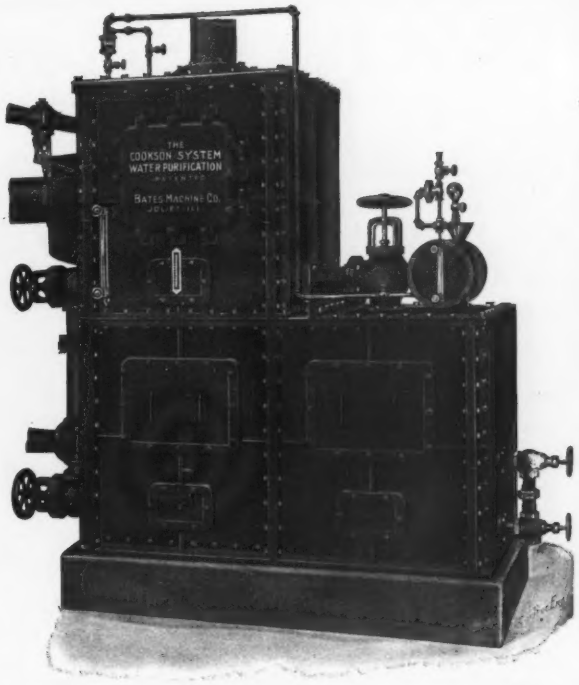
The "Goubert" **eliminates expansion troubles** by means of a flexible expansion plate of sheet copper between the tube plate and the upper end of the shell.

If you contemplate the purchase of a Feed Water Heater, give us an opportunity to go more into detail and really show you that one of these will do your work as you want it done.



A copy of our Feed-Water Heater Book will help you to a wise and lastingly satisfactory selection. Ask for it.

The Griscom-Spencer Co.
90 West Street, New York



Anybody Can Handle The Cookson System of Water Purification

No feed water is too bad for the removal of its impurities in this apparatus. Cookson systems are giving excellent service with water containing as much as **96** grains of solid matter per gallon, **56** grains of which are sulphate of lime.

Cookson Purifiers embody all vital features of our Standard Combination Exhaust Steam Feed Water Heater, Filter, Oil Separator and Receiver but are also provided with extra large water storage space, suitable apparatus for feeding the purifying chemicals, a special filter bed for removing the precipitate, and a testing chamber to enable the operator to determine the condition of the water at any time.

The whole device is simple, effective and can be cleaned without boiler shut down or stopping of the purifying process.

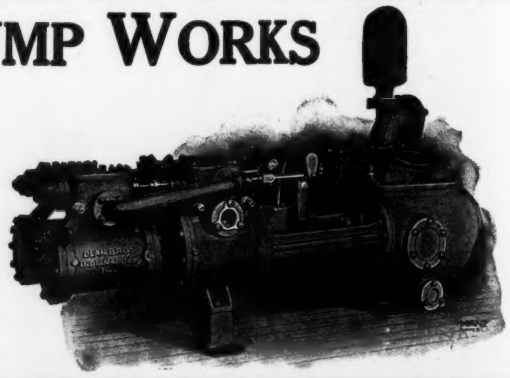
Our engineering experience for determining the size and type of apparatus for given conditions is at your service. We install the Cookson System upon unmistakable guarantee as to its performance. Tell us your feed water troubles and ask for literature.

BATES MACHINE CO.
Builders of Cookson Heaters and Purifiers and Bates Corliss Engines
710 Henderson Ave., JOLIET, ILL.

DEAN BROS. STEAM PUMP WORKS

INDIANAPOLIS, IND.

DURABLE DUPLEX AND SIMPLE PUMPS. JET AND SURFACE CONDENSERS. HYDRAULIC PRESSURE PUMPS with UNBREAKABLE FORGED CYLINDERS.



We make the only DUPLEX PUMP that will not short-stroke; Valve Gear without rock shafts. Perfected new patterns of both Duplex and Single types of Pumps. Vertical type of Duplex Pumps in new design. ATLANTIC type of Vertical Boiler Feeder. Write us.

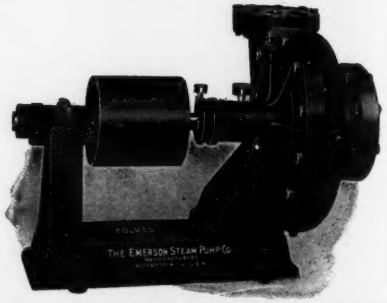
BEFORE PURCHASING YOUR PUMPING EQUIPMENT

Let us give you figures on our new production, the **"Holmes"** hydraulically balanced **Centrifugal pump**, vertical or horizontal shaft. It is more economical than any other pump on the market. Efficiency unequalled and guaranteed. We build these pumps to be belt driven, or direct-connected to electric or water Motors, Steam Engines or Turbines, Gas or Gasoline Engines, and to suit any special condition of operation.

Submit your pumping problems—and we will give you an estimate on pump alone, or on complete pumping outfit.

Also ask for information on the **Emerson Patented Foot Valve** and **Quick-Cleaning Strainer**—the best on the market.

Ask for Bulletin 1-B.



THE EMERSON STEAM PUMP CO., ALEXANDRIA VIRGINIA

Engines Repaired Everywhere !

The minute we get your order to repair Engines, Ice Machines and Pumps, we are on the job with a hustle and experience that saves delays and shut-downs for you.

We don't experiment on your valuable machines. We send the proper tools, those best adapted for the work and men who know from long experience what to do.

When you need first-class repairs, send for us as the quickest and surest way out of trouble.

H. B. UNDERWOOD & CO., 1020 Hamilton St., Philadelphia, Pa.

Manufacturers of Portable Tools

Automatic Pump and Receiver

HEATING SYSTEMS

Simplex, not Duplex
"To be simple is to be great"

are much more efficient when the water of condensation is handled by

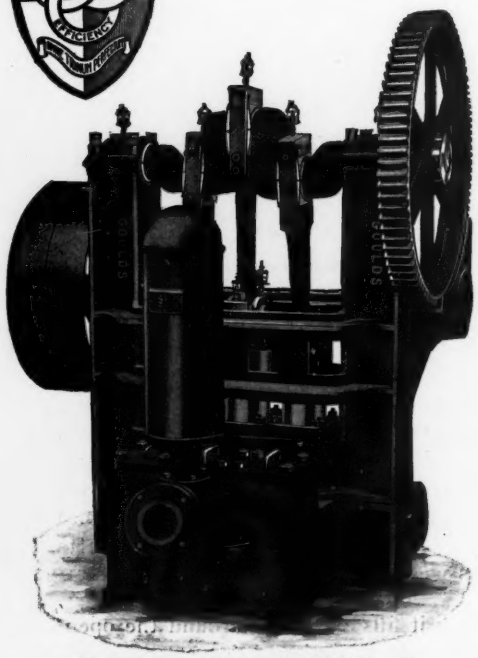
Marsh Automatic Pumps and Receivers or Marsh Vacuum Pumps

Our New Catalog 18-V Sent on Request.

Steam and Power Pumping Machinery for Every Service.

AMERICAN STEAM PUMP COMPANY . . . . Battle Creek, Mich.

GOULDS



Goulds Triplex Power Pump for 200 lbs. Pressure

Electric Pumps. Circulating Pumps
Elevator Pumps. Triplex Pumps
Boiler Feed Pumps. Semi-Fluid Pumps
Irrigation Pumps. Air and Vacuum Pumps
Fire Pumps. Rotary Pumps
Centrifugal Pumps. Chemical Pumps
Brine Refrigerator Pumps. Water Works Pumps

THE GOULDS MFG. CO.

57 W. Fall Street
Seneca Falls, - - New York

BRANCHES
New York Chicago Philadelphia Pittsburg Boston
Jacksonville Charlotte Louisville St. Louis Los Angeles
San Francisco New Orleans Denver Seattle Montreal Toronto

610

A 50% Gain in Heater Efficiency

The BARAGWANATH
Steam Jacket Heater
Does Double Service

You can see by the accompanying illustration how the BARAGWANATH heater is more efficient than others. It's a case of utilizing the steam which, in other heaters, goes to waste.

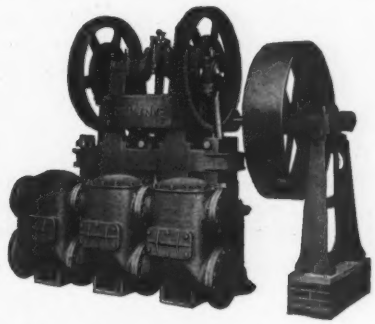
In the BARAGWANATH the steam enters the heater at the bottom and passes up through the tubes—just as in other heaters. **Then** it returns through the space between the water chamber and the outside wall. It's a clear case of double heating service. Send for the BARAGWANATH book.

WM. BARAGWANATH & SON
1263 West Division St., Chicago

AGENCIES: W. S. Gregg, Dwight Bldg., Kansas City; E. A. Field, Buhl Block, Detroit; The Corbin Co., American Bank Bldg., Seattle; S. B. Whinery, 95 Liberty St., New York; Summit Engineering Co., House Bldg., Pittsburg; Manning-Hughes Co., Camden, S. C.

Deming Pumps

For All Uses And Any Power



For operation by any power.
For boiler feeding or any place where a pump can be used, DEMING TRIPLEX POWER PUMPS meet all requirements.

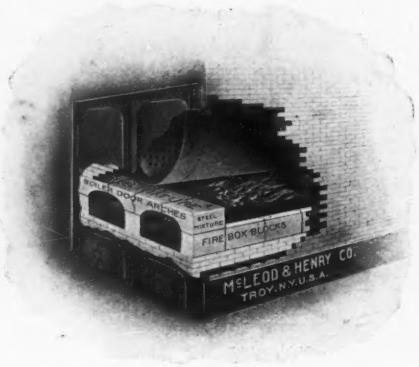
Write For Catalogue.

The Deming Company
Salem, Ohio

HENION & HUBBELL, Chicago, Gen'l Western Agents
Other Agencies in all principal cities.

"STEEL MIXTURE"

Should Be Used in Every Power Plant



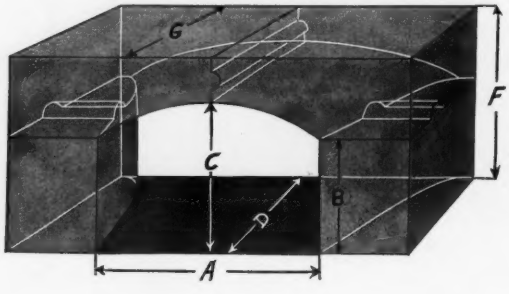
THERE are over four thousand plants using it now and more coming in every day. They find that it makes boiler setting renewal easy as well as unusual. If you use it in your plant, you will have the same experience.

The material has been specially developed for its purpose. In a boiler furnace the lining has to resist both heat and abrasion. It has to be both hard and refractory. "Steel Mixture" combines these two qualities in as high degree as possible. It also has one other advantage. It can be successfully moulded into the large, heavy forms that make up the different parts of the setting as we furnish it.

Take our boiler door arch for instance. You can see how it fills the space around the openings, protecting the front and holding up the brickwork above. It is designed for strength and durability. There are but few separate pieces and these are heavy and solid so as to stand all kinds of abuse. For further security they are fitted together with tongues and grooves.

It is an arch made in a practical manner to fill a practical want. It does away with what has always been a weak point in the setting. You can get one to fit your boiler without any delay.

Why not try a set when repairing next time? You can see from the lower cut just how the arch goes together. It shows the arch as used for one door opening but we make them in sets for any number of openings. The letters indicate the measurements we need in order to quote prices. If there are two or more openings we need the distance between them also.



Write now, send us these dimensions, and we will tell you how much an arch to fit your boiler will cost delivered at your station. You may not need one at present but you will some day. Be prepared when the matter comes up.

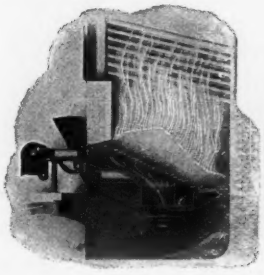
We would like every reader of this paper to have a copy of our "Measurement Booklet" on file. It tells all about our product. Write and ask for it.

McLeod & Henry Co., Troy, N. Y.

New York Office, 1402 Broadway

Underfeeding—Gravity Cleaning

All engineers recognize that **Underfeeding** is the only scientific method of supplying coal. **Gravity Cleaning** is the only way to keep down labor expense and get maximum capacity and efficiency. The



TAYLOR STOKER

is the only stoker in which these features are combined.

American Ship Windlass Co.

General Sales Office and Works:

Providence, R. I.

Lenher Engineering Co., New York City, Sole Agts., N.Y., N.J., Penn. (15-48)

HEATED AIR, STEAM, SMOKE AND DUST

easily and permanently removed from power plants, mills and other kind of buildings by the use of the

"VACUUM" VENTILATOR

Our specialty is the relief of uncomfortable conditions caused by poor ventilation.

Write for our Booklet "E" which describes the principle and operation

THE VACUUM VENTILATOR COMPANY
421 Atlantic Avenue - - Boston, Mass.

Lower Your Boiler-Setting Upkeep by Using

Betson's Plastic

the Logical Fire Brick

Comes in bulk moist and plastic ready for instant use—is free from expansion and contraction and can be shaped into any form in any place. Makes a practically indestructible one-piece arch or side wall lining. No need of sending for outside aid when repairs have to be made. Have a barrel handy. Our catalog shows a way to boiler-room economy.

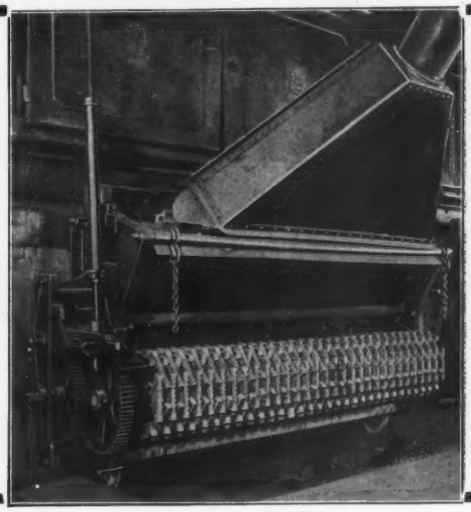
SEND FOR IT TODAY

BETSON PLASTIC FIRE BRICK CO., Rome, N.Y.
(Practical Agents Wanted)

What a Mechanical Stoker Will Do

is of far more importance than what **it** is.

Most any sort of a foundry can make castings. Any machine shop can turn out parts. Any mechanic can assemble them. Then what?



Here are some of the things that the

Green Chain Grate Stoker Will Do

It Will

Reduce Fuel Cost

Burn low grades of coal with greater steam-producing results than any other method of stoking.

Burn successfully coals which "clinker" on any other grate.

Eliminate excess air and increase operating efficiency.

Give uniform boiler temperatures at all times.

Increase capacity of boiler while decreasing fuel consumption.

Reduce boiler-room labor.

Eliminate all smoke.

Always keep grate surface clear and clean; never require hand-cleaning.

Notwithstanding its mechanical perfection, it will not accomplish these results unless conditions, as a whole, are suited to use of a stoker.

And **that** is why automatic stoking is an engineering problem.

And **that** is why we will not, as manufacturers, recommend the installation of a Green Chain Grate Stoker unless our engineering experience and knowledge convinces us that conditions can be modified or provided, to assure that the operation of our Stoker will be profitable to our customer, as well as a credit to our product and its installation.

This policy has put in successful use over One Million Horse Power of Green Chain Grate Stokers.

We are ready to "show you."

And while you are considering boiler-room economy, don't forget to ask us about the

Geco Pneumatic Ash Handling System

which provides the cheapest and safest way of handling ashes.

Green Engineering Company

General Offices: 1340 Steger Bldg., Chicago
Shops: East Chicago, Ind.

Manufacturers also of

GECO RATCHET ASH DRAGS—
GECO PRESSURE WATERBACKS
GECO VENTILATED FLAT IGNITION ARCHES

WILL YOU LET WHAT THESE

Here are a few well known manufacturers who are using Wilkinson Stokers:

Pittsburg, Plate Glass Co., Pittsburg, Pa.
Pennsylvania Railroad Co., Jersey City, N. J
Southwark Mills Co., Philadelphia, Pa.
Baldwin Locomotive Works, Philadelphia, Pa.
Hoopes & Townsend, Philadelphia, Pa.
Waldorf-Astoria Hotel, New York, N. Y.
Vulcanite Portland Cement Co., Vulcanite, N. J.
United States Navy Yard, Washington, D. C.
Oesterr Alpin Montan Gessellschaft, Vienna, Austria.
Pennsylvania Sugar Refining Company, Philadelphia, Pa.
Spencer Kellogg Co., Buffalo, N. Y.
Willard's Hotel Co., Washington, D. C.
Bellevue-Stratford Hotel, Philadelphia, Pa.
Schwarzschild & Sulzberger Co., New York, N. Y.
Department of the Interior, Washington, D. C.
American Linoleum Mfg. Co., Linoleumville, Staten Island, N. Y.
The Plaza Hotel, New York, N. Y.
Atlantic Portland Cement Co., Nazareth, Pa.
The Gutta Percha & Rubber Mfg. Co., Toronto, Canada
Duff & Repp Bldg., Kansas City, Mo.

Sign this Coupon for our Catalog.

Doesn't the SIMPLICITY of this mechanism appeal to you? Here is the complete

Wilkinson Stoker,

The hopper, the inclined hollow grate, ash table, ash slide, motor, and driving mechanism.

There are no moving parts exposed to the action of the fire, simply a row of very heavy grate bars provided with a **steam jet service for their preservation.**

Two small hydraulic motors are directly connected to the moving grates. The few levers and slow speed make this mechanism extremely simple, durable and effective. The power required for stoker actuation varies from ½ to 1½%, which is less than required for any other stoker on the market.

Note the heavy form of side supports, extremely heavy grate bars and heavy ash rests, also the special spring side bars at sides to keep the grate bars close together and entirely eliminate the wastage of fine fuel into the ash-pit.

No other stoker is as easily accessible as the **Wilkinson.** If necessary a grate bar can be removed while the fire is burning, only necessitating the stopping of the stoker for a few minutes. You know the trouble it is with other types of stokers to provide a track, run it out in front of the boiler, stop the boiler, and go to all this trouble before you even make the repairs.

Now there are lots of good points about the Wilkinson Stoker, and we want to tell you the whole story.

Won't you send us this Coupon right now for our Catalog.

Sign COUPON Right

In the Wilkinson Automatic Stoker and The American Feed Water Purifier, both of which we are now manufacturing under the name of the Wilkinson Foundry and Manufacturing Company, we are offering two devices which will make a bigger saving in your present expense than any investment you could possibly make in your boiler room.

The Wilkinson Automatic Stoker has been on the market so many years and has proven so successful during all these years that there is little more can be said to strengthen the reputation it already enjoys.

Read the partial list of users printed herewith.

The endorsement of any one of them would be enough assurance to prospective purchasers of the efficiency of the stoker, but the endorsement of them **all** is absolutely **conclusive proof** of the superiority of **the Wilkinson Stoker.**

The American Feed Water Purifier differs from the Wilkinson Stoker in that it is a simpler—**less costly**

COUPON

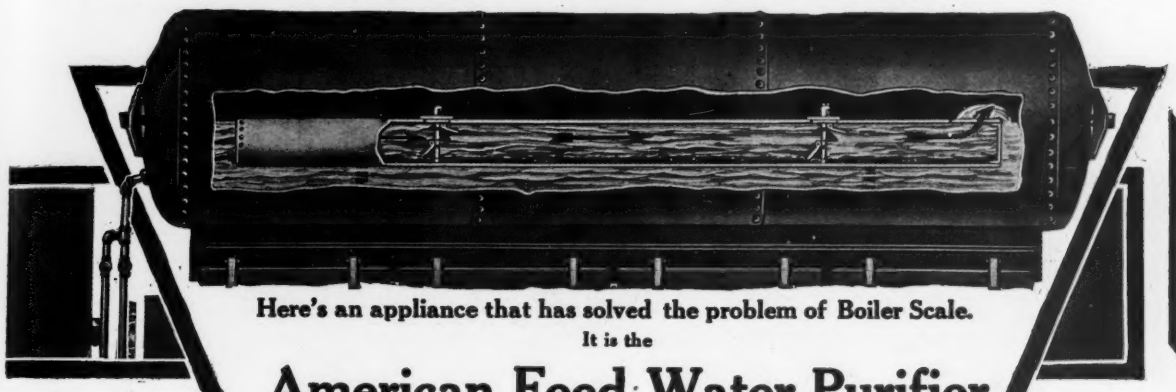
GENTLEMEN:—You may send me catalog and testimonials on the Wilkinson Stoker, adv. in Prac. Engr., Dec.

Name .....
Firm Name .....
Address .....
No. of boilers .....
Type .....
H. P. .....

THE WILKINSON FOUNDRY

BRIDGEPORT - MONTGOMERY

US SHOW YOU
TWO DEVICES WILL DO FOR YOU?



Here's an appliance that has solved the problem of Boiler Scale.

It is the

American Feed Water Purifier

This is how:—

It takes the scale forming substances **out of the feed water before it reaches the boiler** instead of letting them form into scale and trying to get them **out of the boiler.**

Read This:—

It is when scale forming elements are subjected to the **extreme heat** of the boiler that they precipitate and form into scale. Now, if you can make them precipitate and remove them **before** they enter the boiler, isn't it a much more sensible proposition?

Feed water heater manufacturers claim to do this, but just stop and consider a minute; it requires a temperature of nearly **300** degrees to precipitate **all** the scale forming salts in the water, and the average feed water heater seldom reaches over **200** degrees. See the fallacy?

Inside the boiler, at a pressure of only **100** lbs. there is a temperature of 337 degrees, a great deal **more** than is necessary to precipitate **all** the salts, so that's where we put the **American inside** where it is subjected to **all** the heat of the **boiler itself.**

We put the American Feed Water Purifier up to you purely on its merits—we're glad to let you have one on 30 days free trial, when it can speak for itself.

This offer in itself is about the safest evidence you could have of the merits of the American.

Will you give us this chance to show you what a saving we can make?—let the American **prove** itself before you go to any further expense for scale removing.

Please tear out, send us your name and address on the coupon

Read what these two users say about the American Feed Water Purifier:

GENTLEMEN:

The American Feed Water Purifier was installed in one of the boilers of this plant on August 28th, 1901, and has given perfect satisfaction, and done all that was claimed for it.

It has been in almost constant service day and night since it was installed, and has been under my personal supervision.

It prevents scale, and keeps the boiler from foaming and is satisfactory in every respect.

Yours truly,

EUGENE L. BACHMAN, Chief Engineer Philadelphia County Prison.

To whom it may concern:

This is to certify that we have used the purifiers —— —— for five years with entire satisfaction to us. It has been a boon to our engine room force; where before installing them we were required to clean out at least once a month, we now run for six months and then only let down in order to thoroughly clean out under and around them. Money could not buy them were it impossible to duplicate them. Respectfully yours,

JAMES W. PEARCE,
Chief Engineer,
Phil. J. Walsh Estate,
Philadelphia, Pa.

Fill out and mail us this Coupon NOW!

the PONS Now!

device, but the **economy** it effects is none the less important.

It is fully described under the picture, and its operation is so logical that it can be readily understood how effective it is in practice.

But, aside from this, the fact that it is now being manufactured by the manufacturers of the Wilkinson Stoker is further evidence of its efficiency.

Besides, did you read the couple of letters printed herewith from users of this purifier?

Will you find out for yourself just what these two devices can do for you, by signing and mailing the attached coupon right now?

We want reliable agents in all parts of the country and will be glad to correspond with you, if interested, for exclusive territory.

COUPON

GENTLEMEN: You may send me special offer and all descriptive matter on your American Feed Water Purifier, adv. in Prac. Eng., Dec.

Name.....

Firm Name.....

Address.....

No. of boilers.....

Type.....

H. P.....

AND MANUFACTURING CO.
COUNTY - PENNSYLVANIA

...LAIN CO. PHILA

Stop it, if you're doing it.

For **humanity's sake,** if you care for humanity.

For your **Pocket's sake,** if you care for your pocket.

For **safety's** sake, if your city's smoke inspector is busy.

For your **reputation's** sake, if you care for **that.**

But, for **Goodness Sake,** stop it!

It is easier than not, and a lot cheaper in the long run—the Hawley way.

FITS ANY BOILER

THE HAWLEY DOWN-DRAFT FURNACE IS GUARANTEED TO EFFECT 95 PER CENT SMOKELESSNESS.

And to save 10 per cent to 20 per cent of your present fuel bill.

Coal is roasted and volitilized on the upper or water-tube grate.

Hot embers fall through this upper grate to a lower one.

The space between these two grates is a furiously hot retort, in which all the gases are consumed in a Bunsen-like flame, under the powerful down-draft of air through the tubes of the upper grate.

Let us tell you exactly what we will guarantee to do for you.

HAWLEY DOWN-DRAFT FURNACE COMPANY, 736 West Monroe Street, Chicago

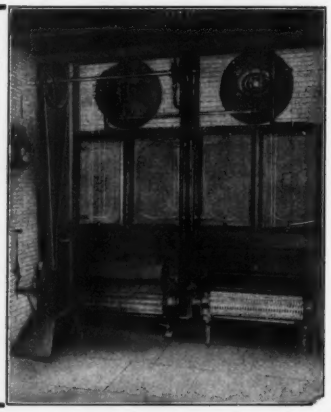
CROWE SMOKELESS STOKERS

cut down your operating expenses and increase the efficiency of your plant. They give you practically perfect combustion—eliminate smoke. "Grate Talk" tells *why* and *how*.

Write for a copy today

PAUL L. CROWE
47 Montgomery St. Jersey City, N.J.

BRANCH OFFICES
Cleveland, - - - Ohio
Rockerfeller Bldg.
Boston, - - - Mass.
166 Devonshire Street—J. F. Foster



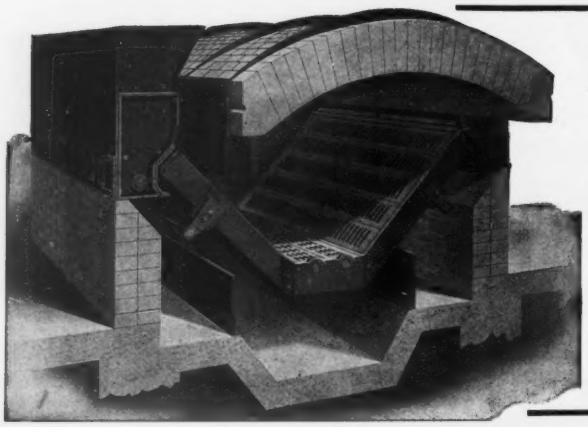
We Make a Superior Quality

and a large variety of

BRICKS, BLOCKS, and TILES.

CYRUS BORGNER CO.
23rd ST. ABOVE RACE PHILADA. PA. U.S.A.
FIRE BRICK AND CLAY RETORTS
SPECIAL SHAPES TO ORDER

Write for information and prices



McKenzie Dutch Oven Magazine Furnace

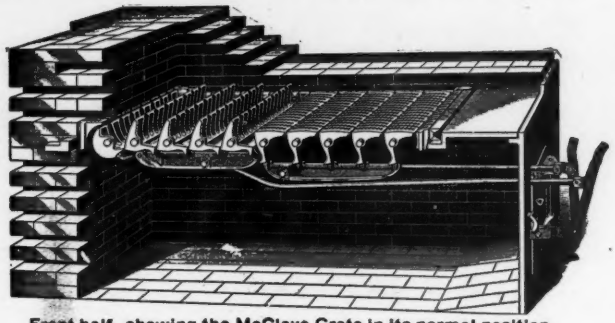
WHERE large stokers are not adaptable and high economy is desirable the **McKenzie Furnace** will meet all requirements succesfully. It will pay you to investigate the merits of our products.

We maufacture the
McKenzie Traveling Grate Stoker
McKenzie Chain Grate Stoker
McKenzie Coking Coal Stoker
McKenzie Anthracite Coal Stoker
McKenzie Stationary Grate
McKenzie Igniting Arch
McKenzie Locomotive Shaking Grate

Our Catalog will describe them more fully. Write for it TODAY.

McKENZIE FURNACE COMPANY, CHICAGO, ILL.

McCLAVE GRATES



Front half, showing the McClave Grate in its normal position.

IN COMBINATION WITH

McClave's ARGAND BLOWER

Argand Blower.

These form the most complete system for burning all kinds of anthracite and bituminous fuel, such as rice, bird's eye, buckwheat, slack, screenings, duff, coke breeze, etc., while the grate alone is unequaled for burning the large sizes of either variety of coal by natural draught. This construction will bear the closest inspection and expert investigation. *Its use will prove every claim made for it.* **McClave's Argand Blower** furnishes a large volume of air with a small amount of steam. The air and the steam are thoroughly mixed in the shell of the blower before the blast is delivered into the ash pit. It makes very little noise in operation.

For full particulars send for Illustrated Descriptive Catalog "D"

F. G. SMITH, Western Mgr., 1018 Fisher Bldg, Chicago

McCLAVE-BROOKS CO., Scranton, Pa.

CHAS. N. HAYS, Sales Agt. 1007 Empire Bldg. Pittsburg

S. C. SMITH, Manager, Fulton Bldg., 50 Church St., New York

Repeat Orders

56%

During the fiscal year ended June 30, 1910, an aggregate of ***97,300*** rated boiler horse-power of

JONES STOKERS

were sold. Of these sales, 54,605 horse-power, or ***56 per cent,*** were on ***repeat orders.*** The ***Jones Stoker*** stands on its merits. Fair play and honest sales methods by its manufacturers count. Users of the ***Jones Stoker*** are our friends—they are satisfied customers, and that's what we strive for—for they come back.

THE UNDER-FEED STOKER CO. OF AMERICA

General Offices: Marquette Bldg., Chicago

New York Philadelphia Boston Pittsburg Detroit Buffalo Cincinnati Toledo

THE BABCOCK & WILCOX COMPANY,

85 LIBERTY STREET, NEW YORK

Babcock & Wilcox—Stirling—Rust

Water Tube Steam Boilers

STEAM SUPERHEATERS. MECHANICAL STOKERS.

Works: BARBERTON, OHIO; BAYONNE, N. J.

BRANCH OFFICES

Atlanta.....Candler Building	Denver.....435 Seventeenth St.	Pittsburgh.Farmers' Deposit Bk. Bldg.
Boston.....10 Post Office Square	Havana, Cuba.116½ Calle de la Habana	Portland, Ore....Wells-Fargo Building
Chicago.....Marquette Building	Los Angeles..American Bank Building	Salt Lake City.....313 Atlas Block
Cincinnati.....Traction Building	New Orleans.....Shubert Arcade	San Francisco.....99 First St.
Cleveland.....New England Building	Philadelphia..North American Building	Seattle.....Mutual Life Building

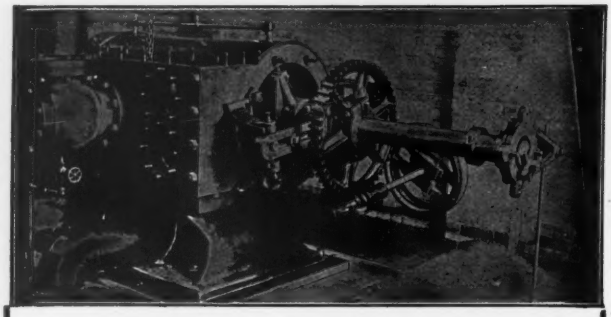
HEINE WATER TUBE BOILERS

and SUPERHEATERS.

WE HAVE A LARGE SHOP AT BOTH ST. LOUIS AND PHOENIXVILLE, PA. BOTH ARE THOROUGHLY EQUIPPED FOR PROMPTLY EXECUTING LARGE ORDERS OF LARGE UNITS. SIZES 70 H. P. TO 700 H. P.

"BOILER LOGIC" and "SUPERHEATER LOGIC" tell about our Product. FREE!

HEINE SAFETY BOILER CO. ST. LOUIS MO.



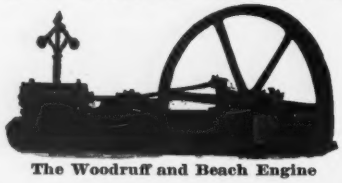
Lee's (Patented) Improved Portable Boring Tool in position

Engine Repairs

St. John Self-Adjusting Cylinder Packing

Price, $5.00 per inch

With our improved methods and tools we can repair your engine without removing from foundation and save hours of shut-down. Engines adjusted.



The Woodruff and Beach Engine

We have the drawings and patterns and keep a line of repairs finished and part finished on hand for Hartford, Buckeye, and Woodruff & Beach Engines.

HARTFORD ENGINE WORKS, Hartford, Conn.

Successors to HARTFORD ENGINEERING CO.

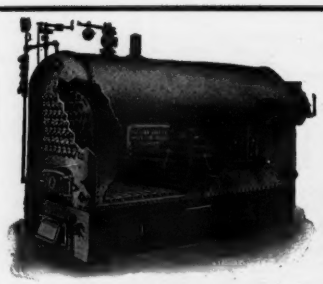
Builders of the Improved Hartford Buckeye Engines.

More Boiler Capacity

GREEN ECONOMIZERS make it possible to increase the steaming capacity of your plant, and at the same time to reduce the fuel cost per H. P. hour. Moreover, economizers protect the boilers from strains due to cold water, keep in reserve an hour's supply of water heated to boiling point for meeting sudden overloads, and prevent a large amount of scale-forming matter from entering the boilers. Write for Catalog "PE106."

231P

THE GREEN FUEL ECONOMIZER CO., Matteawan, New York



Star Safety Water Tube Boiler

Star Safety Water Tube Boilers

For Power, Steam Heating and Hot Water Heating. Most economical boiler on the market today. No brick setting required. Saves space.

New Star Down-Draft Steel Boilers

Steam and Hot Water Heating. Constructed of best Open Hearth Flange Steel and Charcoal Iron Tubes.

Harrisburg Improved Double Drum Warm Air Furnace

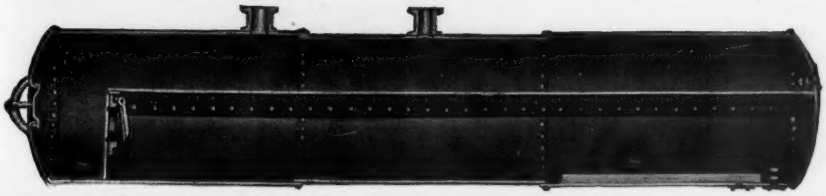
Thousands in use.

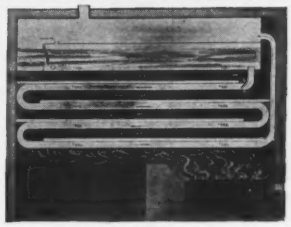
Riveted Steel Water Pipe, All Diameters and Gauges

Write for Catalogue and Circulars

HARRISBURG MFG. & BOILER CO., Harrisburg, Penna.

DRY STEAM UNDER ALL CONDITIONS





Here is the principal of the Parker Downflow Boiler shown diagrammatically. It also gives you a clear idea of the location of the steam drum and arrangement of its separate compartments for steam and water.

HOW THIS IS ACCOMPLISHED IN THE PARKER DOWNFLOW BOILER

Now the great fundamental principal of this boiler is that the flow of water is opposite in direction to that of the gases.

And it is the application of this principal which enables us to guarantee dry steam under all conditions as it permits us to keep the water and the steam in entirely separate chambers; (shown above).

Look at the diagram on the right. The drum is divided into two separate compartments—the flow of water is from the lower one, through continuous elements, the coolest water coming in contact with the coolest gases, until the steam is delivered directly from the hottest part of the furnace through the vertical upcast to the steam chamber without passing through water. Now that is why a uniform dryness is insured under all conditions.

Look at the large picture of the steam drum. Notice the anti-priming valve between the two compartments. When a drop in pressure occurs this anti-priming valve closes, and the difference in pressure between the two chambers keeps it closed while the drop continues. This effectively prevents priming and accelerates the flow in the tubes, rather than retards it, as is the case when inclined water tube boilers are called suddenly upon for steam. This water chamber is never subjected to high temperature, and owing to the entire absence of ebullition, forms an exceptionally large settling chamber or mud drum.

This is one of the reasons for the success of the Parker Downflow Boiler. Now we have a whole lot of testimonial letters. There's likely one from a user in your neighborhood. Fill in the coupon, let us send you our catalog and get in touch with this user who is near you. See what he says.

Send us the coupon now, before you forget.

COUPON

Parker Boiler Co., Pennsylvania Bldg., Phila., Pa.
Gentlemen:—You may send me your Downflow Booklet as Adv. in Prac. Eng. Dec.

Name .....
Position .....
City .....
No. H. P. and make of boilers .....

PARKER BOILER COMPANY

Main Offices, 1007 Pennsylvania Bldg. Philadelphia, Pa.

EDGE MOOR

WATER TUBE **BOILERS**

Simplicity, efficiency and accessibility to all parts are features of these boilers.

EDGE MOOR IRON CO. EDGE MOOR, DELAWARE

WICKES

Vertical Water Tube Boiler

Did you ever pull water from boiler with engine?

Do you know the result?

The Wickes Boiler uses the old plug-hat dome idea of great height from water line to steam outlet.

You don't pull water over from this boiler.

Ask us for bulletins —sent free.

The Wickes Boiler Co.

Main Office and Works, SAGINAW, MICHIGAN

Sales Offices:
1411 West Street Bldg., West and Cedar Sts., New York City
1139 American Trust Bldg., Chicago, Ill.
Penobscot Bldg., Detroit, Mich. Empire Bldg., Pittsburg, Pa.
918 Brown-Marx Bldg., Birmingham, Ala.
22 State St., Grand Rapids, Mich. Seattle, Wash.

Fire and Water Tube Boilers

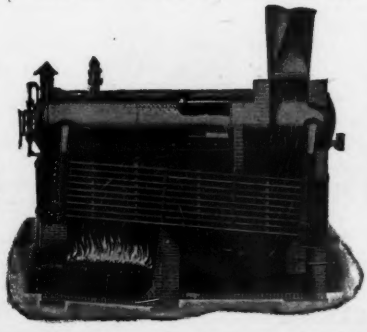
All Wrought Steel Construction

Established 1865.

E. KEELER COMPANY

Williamsport, Pa.

Boston Wilkes-Barre
New York Philadelphia
Chicago San Francisco
Houston



Robb-Mumford Boiler Co.

Successors to

Edward Kendall & Sons,
Charles River Iron Works

Manufacturers of

Return Tubular, Water Tube, Internally Fired and other Types of Boilers, Smoke Stacks, Tanks.

Works: South Framingham, Mass.

Sales Office— 131 State St., Boston.

The Name KEWANEE

on a boiler is the guarantee that it is a **good** boiler. The design and workmanship of a **Kewanee** boiler puts a stamp upon it that cannot be erased. **It is the stamp of KEWANEE Quality.**

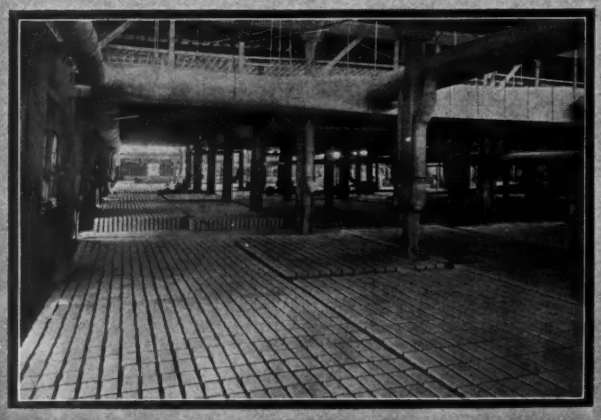
Kewanee Quality leaves a true sense of economy and efficiency with the owner. He knows his boiler is going to last him with the hardest kind of firing. It means a smile of satisfaction on the engineer's face. It means that the engines are going to run. It means more than that—much more. It means that KEWANEE Boilers are stayed and braced in the most scientific manner, **solid, weldless steel braces.** It means the best material that can be put into a boiler—**seamless tubes, etc.** It means the best accessories that can be put on a boiler—**cast semi-steel lugs, steel man-holes and heavy cast plates.** It means the very best workmanship possible—**good men with good tools.**

Write to the Old Man Behind the Boiler. He doesn't sit in a revolving chair looking at his spats. He's on the job all the time, and all on the square, the old man is. He will steer you right. Send for Catalogue 50.

KEWANEE BOILER COMPANY

—Branch Offices—
Chicago, St. Louis, Kansas City

KEWANEE, ILLINOIS



One of our Tempering Floors, showing Standard Sizes

A Few Points of Difference between

Harbison-Walker BOILER SETTINGS

and ordinary settings:

¶ Harbison-Walker Settings—last longer—because of selected clays.

¶ Harbison-Walker Settings—lay cheaper—because of good workmanship.

¶ Harbison-Walker Settings—are gotten quicker—because of better stocks and shipping facilities.

¶ Be on the safe side—specify Harbison-Walker Settings.

Harbison-Walker Refractories Company

PITTSBURGH :: :: :: PENNSYLVANIA

SALES OFFICES
Pittsburgh, Chicago, Philadelphia, New York, Birmingham

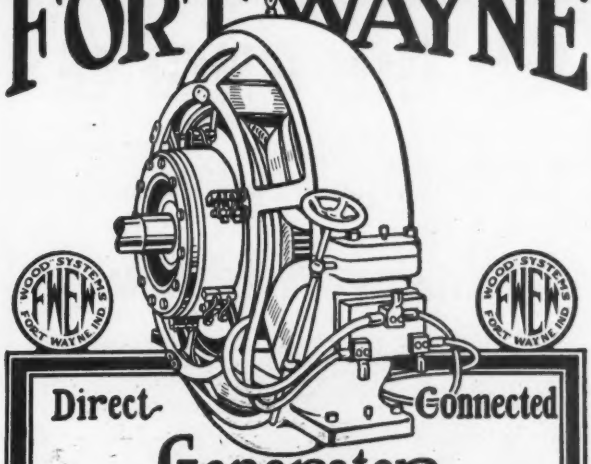
PLANTS IN
Pennsylvania, Indiana, Alabama, Ohio, Kentucky

Scoring of Cylinders
is overcome.
Friction & Wear
are reduced
by
Facing Pistons with
ALLAN METAL

Applied to thousands of pistons during the past 18 years.
Our booklet—Yes, sent on request.

A. ALLAN & SON,
484 Greenwich St.,
NEW YORK

FORT WAYNE



Direct Connected
Generator

Built especially for plants furnishing direct current to factories, mines, mills or small towns for power and lighting.

It's extremely low operating expense is only one of its many advantages.

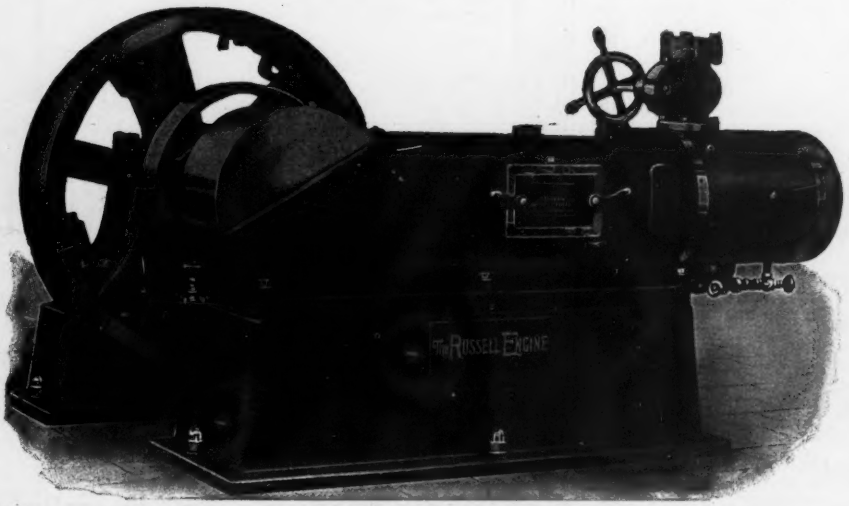
If you want a generator that will continue year after year to give the maximum of service with the minimum of attendance, repairs and floor space, it will pay you to send for our illustrated Bulletin 1079 and get a detailed description of our Type MPL.

FORT WAYNE ELECTRIC WORKS
"Wood Systems"
1620 Broadway, Fort Wayne, Ind.
Branch Offices Most Large Cities 69

The Economical, Efficient "RUSSELL"

THOSE who have watched installations of the RUSSELL ENCLOSED SELF-OILING SINGLE VALVE ENGINE for the past 25 years know that its economy and efficiency are proven facts. Its design and construction permit nothing else.

The RUSSELL ENGINE has few parts and such as it has are simple, compact and durable. But with fewest possible parts it contains all that is essential to successful and continuous operation.



In general design it is pleasing in appearance, but its construction is massive and rigid to a degree that makes springing and the consequent wear impossible. Among other features of this Engine is a system of lubrication which allows constant smooth running from January to December, and it's something you should know about. Fully described in Special Catalogue sent upon request.

The Russell Engine Co.
Massillon, Ohio, U. S. A.

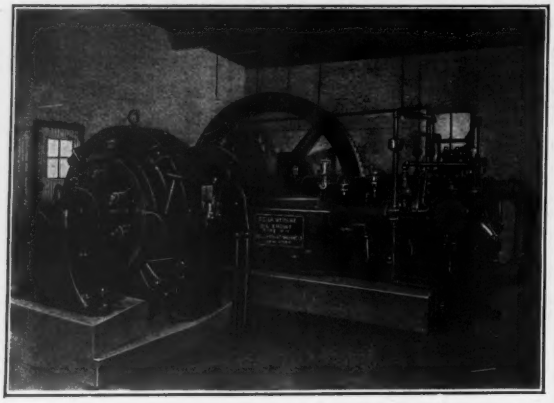
AN OIL ENGINE

COMBINING

SPLENDID REGULATION

WITH THE

HIGHEST FUEL ECONOMY



The new **De La Vergne Type "FH" Oil Engine** combines, as never before, these two primary essentials of the up-to-date electric power generating unit.

Regulation:—We sell the "FH" Oil Engine under **a guarantee that its speed variation will not exceed the following:—**

Ordinary load variations 2%
Quarter to full load..... 4%
No load to full load.....5%

Economy:—The "FH" Engine is sold under **a guaranteed fuel oil consumption not to exceed the following:—**

Full load..... .....0.6 lbs. per B. H. P. Hr.
Three-quarter to half load.....0.65 lbs. per B. H. P. Hr.
Half to quarter load.....0.75 lbs. per B. H. P. Hr.

Knowing the price and weight of fuel oil in your locality, you can easily reduce this to cost per B. H. P. Hour.

Unless your conditions are most exceptional, you will find that the "FH" Oil Engine will give you cheaper power than any other prime mover.

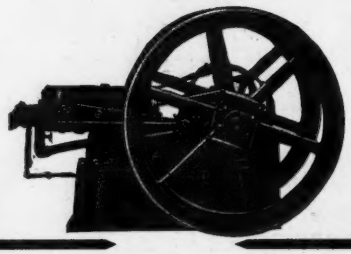
There are six standard sizes—85 to 350 **B. H. P. delivered.** Write us for a copy of Bulletin No. 101.

GAS ENGINES REFRIGERATING MACHINES

DE LA VERGNE

MACHINE COMPANY

1103 East 138th St. NEW YORK



The Best Insurance

against loss due to delays, breakdowns, and other power troubles—is to equip your plant with a simple, efficient, economical, and always dependable I H C Gasoline Engine.

When you choose your engine from the I H C line you can be sure not only of getting the most power from the least amount of gasoline consumption, but just the right style and size to meet your individual needs.

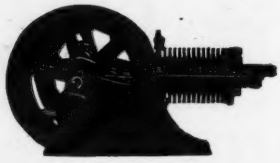
I H C Gasoline Engines

1 to 45 horse power—vertical and horizontal—stationary or portable—have shown their superiority by years of service. They are not an experiment. The correctness of their design has been proved.

It will be to your advantage to learn about the details of their construction before buying any other power. The I H C Gasoline Engine catalogue gives concrete information on this subject. Write for it—today.

INTERNATIONAL HARVESTER COMPANY OF AMERICA
(INCORPORATED)
34 Harvester Building Chicago U S A

Superior Gas and Gasoline Engines

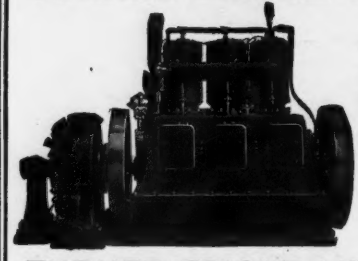


The Gilson is a sturdy and reliable Engine of the four-cycle type. It is simple and strong in construction, and economical in operation; material and workmanship are of the best, and every Engine is guaranteed to deliver more than its rated horsepower. Built in all sizes.

Write for our Catalog.

GILSON MFG. CO., Port Washington, Wis.

TURNER FRICKE GAS ENGINE



A high grade, close regulating engine.

Operating on natural, illuminating or producer gas.

Absolutely guaranteed in regard to operation, workmanship and material.

Agents wanted everywhere.

TURNER FRICKE MFG. COMPANY
Factory, Sharon, Pa. Main Office, Pittsburg, Pa.

Why OTTO Products are Cheapest

WHAT OUR SUCCESS MEANS TO YOU!

SOME SUCCESSES are of the brass band variety. Some of them spring up much like fungus that rises over night, only to wither with the first sun.

But the success of the Otto has been different, for 34 years now we've been building—working out a consistent, steady growth.

In 1876 the Otto was the **only** practical gas engine, and year after year since that time has the Otto forged ahead, each year seeing its improvements and resultant growth of business and reputation.

Today, with over 100,000 Otto engines and over 11,000 Otto Suction Gas Producers in successful operation, the Otto Gas Engine Works, with seven factories in various countries, is the oldest and most successful company in the world manufacturing gas and gasoline engines.

Now, the significance of this to you is:

The Otto Company could not possibly have attained a degree of success beyond all others if the Otto **products** had not also been superior to all other **gas and gasoline engines.**

And, as noted before, it is of still further significance that this success is entirely due to the merits of the Otto products—we having never resorted to "brass band" methods. Now, if you are more interested in **past accomplishments** than **present claims** we want to tell you more about Otto products. That's why the coupon is attached—so that you can drop us your name and address by tearing it out, signing and mailing it to us.

Please do this now.

COUPON

Gentlemen. Replying to your ad. in Prac. Eng Dec. send me catalogs, etc., together with approximate estimate for installing Otto Suction Gas Producer Plant

Of..... ....H. P.

Name .....

Firm name .....

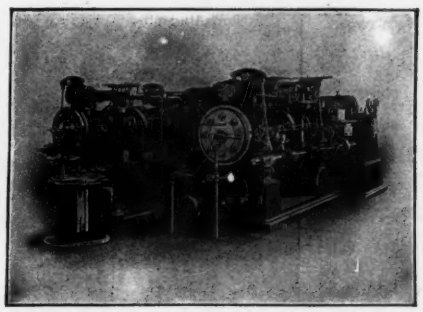
Address .....

Business .....

OTTO GAS ENGINE WORKS, 3229 Walnut St., Philadelphia, Pa.

Branches: Chicago, Boston, New York, Pittsburg, Omaha, Kansas City, Minneapolis, San Francisco

INTERCHANGEABLE parts are not the biggest advantage of Du Bois Engines—nor the least.



Du Bois

Gas and Gasoline Engines

are cast in separate parts, so that the wear in all working parts can be taken up or new parts furnished when necessary, at small cost and with little loss of time.

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We use strong heavy castings—no chance of leakage or breakage.

Get further facts about these strong, sturdy, substantial engines. Get our catalog "B" which tells about our line (5 to 375 H. P.)

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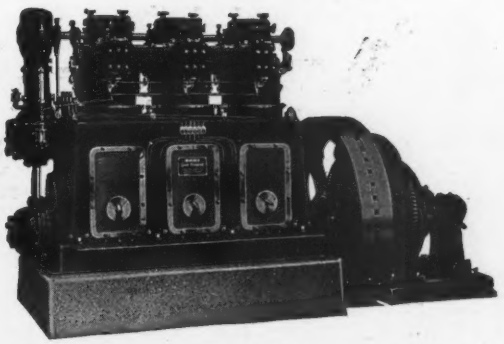
"Warren" Gas Engines

THE IDEAL GUARANTEED POWER FOR ANY SERVICE



One Brake Horse Power Hour on 10,000 B. T. U., which means 12 cu. ft. of Natural Gas, or One and One-Quarter Pounds of Fuel Gasified in Our Suction Gas Producer. It is so much cheaper than any other, in both operating and fuel costs, that it pays back a handsome interest on the money invested in the installation. Regulation sufficiently close to meet the most severe requirements of Electrical Service.

Manufactured by

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WARREN, PA.

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Do any of the tenants in your building complain because the engine makes too much noise or jars the building? Do they object to flickering lamps due to poor regulation? Does the central station power ever fail or the voltage fluctuate?

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American Ball Angle-Compound Units

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These units are absolutely balanced, hence they communicate no vibration to the building. They operate silently, and do not give the hum or roar produced by turbines. They have delicate governors guaranteeing steady lights and their uniform torque (due to the angle construction) allows alternators to operate in parallel without hunting.

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AMERICAN ENGINE CO.

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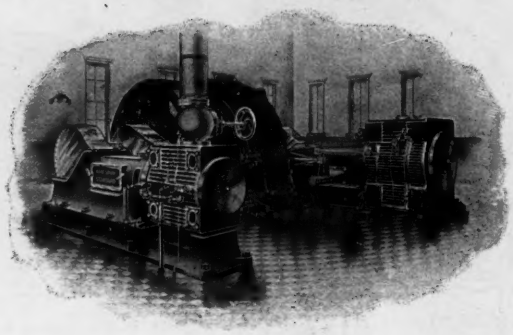

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SINGLE AND CORLISS VALVE
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UNDOUBTEDLY THE BEST ADAPTED ENGINE FOR ELECTRIC GENERATING SERVICE ON THE MARKET

HARRISBURG FOUNDRY and MACHINE WORKS,
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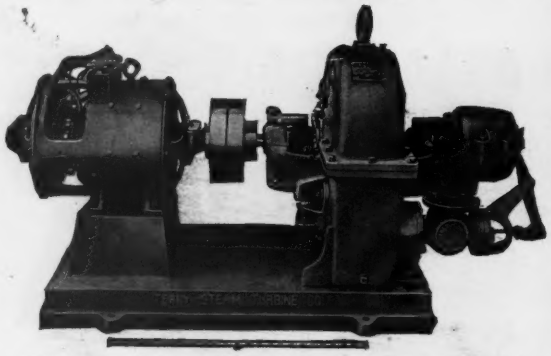
TERRY TURBINES



7½ K. W., 125 Volt, Terry Steam Turbine Generator Set

We build low-speed, direct-connected generating sets from 5 to 300 K. W. capacity, to run condensing or against back pressure into feed water heater.

The operating and steam efficiencies of the Terry Turbine are not reduced through years of service.

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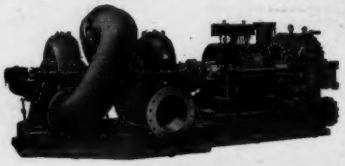
The **De Laval Mixed-Flow Turbine** has two sets of nozzles, one for the low-pressure steam and one for the high-pressure steam. The high-pressure nozzles are as efficient as they would be in a straight high-pressure machine and the low-pressure nozzles are as efficient as they would be in a straight low-pressure machine. Either one, working singly, or together, is as efficient as a corresponding single-pressure machine.



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DE LAVAL (26)
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